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DEVELOPMENT DIGEST

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Gordon Donald, Editor; Pushpa Nand Schwartz, Associate Editor
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दो या तीन बच्चे–
होते हैं घर में अच्छे.
POPULATION

THE INDIAN GOVERNMENT PLACES SUCH WALL PAINTINGS AND POSTERS THROUGHOUT THE COUNTRY TO PUBLICIZE FAMILY PLANNING AND THE DESIRABILITY OF SMALL FAMILIES. THE MESSAGE READS: "TWO OR THREE CHILDREN IN THE HOUSE IS GOOD"
[PHOTO: U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT]

Rapid Population Growth

Study Committee of the Office
of the Foreign Secretary,
National Academy of Sciences,
Washington, D.C.

[The world's population is growing at an ever faster speed; by the year 2000 it is expected to be double its present size, with more than 80 percent of that increase falling in the poorer countries. If developing countries are to escape the serious consequences of such rapid population growth, they will need to undertake unprecedented efforts to bring down their birth rates.]

World population at the beginning of 1970 was over 3.5 billion. Less than two human generations ago, in 1930, it was 2 billion. In little more than one human generation hence, in the year 2000, world population could easily reach 7 billion and possibly greatly exceed this number. Growth rates have quickened: the world population increased from half a billion in 1650 to 1 billion in 1825, to 2 billion in 1930, and to 3 billion in 1960. The acceleration is shown in the ever shorter period required to double human numbers — 175 years between 1650 and 1825; 105 years between 1825 and 1930; and 45 years between 1930 and 1975. Between now and the century's end the developing nations are certain to experience higher growth rates than the economically advanced nations. By the year 2000, the now-developing areas may well number some 5.4 billion persons; the economically advanced nations, some 1.6 billion. Thus, while the modernized nations will increase by some 600 million during the next 30 years, the developing nations could increase by about 3 billion, or five times as much.

The population "explosion" is, in general, the result of great declines in death rates along with continuing high birth rates. When death rates began to fall, as they did in European populations in the 18th

Table 1: Estimates of World Population by Regions

(millions)

Years	World	Africa	Asia		Latin America	Europe		North America	Oceania
			East Asia	South Asia		excl. USSR	USSR		
Carr-Saunders' Estimates									
1650	545	100	327		12	103		1	2
1750	728	95	475		11	144		1	2
1800	906	90	597		19	192		6	2
1850	1,171	95	741		33	274		26	2
1900	1,608	120	915		63	423		81	6
United Nations Estimates									
1920	1,834	136	997		92	485		115	9
1930	2,008	155	1,069		110	530		134	10
1940	2,216	177	1,173		132	579		144	11
1950	2,515	222	1,381		162	571		166	13
1960	2,998	273	794	865	212	425	214	199	16
1970	3,659	348	965	1,108	283	458	254	233	19
United Nations Projections (high variant)									
1980	4,551	463	1,171	1,448	383	492	296	275	23
1990	5,690	629	1,405	1,910	522	526	346	323	29
2000	6,995	864	1,623	2,443	686	563	403	376	35

SOURCE: Tables on pp. 106 and 112 in Volume II.

and 19th centuries, and in non-European populations in the 20th, more and more children survived to adulthood and were themselves able to produce children. Among Europeans and populations of European stock, death rates declined rather slowly, requiring many decades to fall from 30-35 per 1,000 to the 15-20 per 1,000 typical of most less developed countries today. Populations of European stock and, more recently, Japan have largely completed what demographers call the "demographic transition." Birth rates have declined from highs of 30 to 40 or more births per 1,000 population to below 20 per 1,000. Since death rates in these populations have now declined to the level of 10 per 1,000, annual growth rates are 1 percent or less, compared with 2 to 3.5 percent in less developed countries. The great reductions in mortality did not reach the two thirds of mankind in the developing nations in Asia, Latin America, and Africa until after World War II. In general, birth rates have remained high, with the result that these areas are experiencing much higher rates of natural increase than ever occurred in the developed countries of today (this excludes the cases of rapid immigration). Latin America, the most rapidly growing continent at 3 percent per year, will double its population in about 23 years.

We can divide the less developed countries at the present time into three groups: 1) countries with both high birth rates and high death rates; 2) countries with high birth rates and low death rates; and 3) countries with intermediate and declining birth rates and low death

rates. The first group consists of those countries, mainly in Africa and some in Asia, where per capita incomes are extremely low and the process of modernization has barely begun; a few hundred million people are in this group. Most of the less developed countries in Asia and Latin America and some in Africa—with nearly 2 billion people—are in the second group. The third consists of a few countries with perhaps 100 million people on the fringe of Asia and in Latin America, in several of which there has been a marked improvement in economic and social conditions during the last two decades.

Consequences of Rapid Population Increase

Rates of population growth in many less developed countries are at least half the rates of economic growth, and in some cases almost equal the latter. Chiefly because of the high fertility of these countries, the ratios of children to adults are very high when compared with developed countries; and the numbers of young people reaching working ages are rapidly increasing. Both of these factors have serious economic consequences.

Rapid population growth slows down the growth of per capita incomes in less developed countries and tends to perpetuate inequalities of income distribution. It holds down the level of savings and capital investment in the means of production and thereby limits the rate of growth of gross national product. Food supplies and agricultural production must be greatly increased to meet the needs of rapidly growing populations. The number of persons entering the labor force grows very rapidly, while unemployment and underemployment are increasingly serious problems. An ever larger number of workers cannot be absorbed in the modern (industrialized) sector; they are forced into unproductive service occupations or back into traditional agriculture with its low productivity and subsistence wages. Large supplies of cheap labor tend to hold back technological change, and industrialization is slowed by mass poverty which reduces the demand for manufactured goods. In some countries the growing populations outrun the levels at which renewable soil, water or vegetation resources can be sustained, and the resource base deteriorates.

Because the numbers of children grow even more rapidly than the total population, the need for educating ever larger numbers inhibits the raising of school enrollment ratios and improvement in the quality of education. High proportions of children reduce the amount that can be spent for the education of each child out of any given educational budget. The cost and adequacy of health and welfare services are affected by rapid population growth in much the same way. In the individual family, maternal death and illness are increased by high fertility, early and frequent pregnancies, and the need to care

for excessive numbers of children. The physical and mental development of children is often retarded in large families because of inadequate nutrition and the diseases associated with poverty. Poor and crowded housing in the urban slums of rapidly growing cities produces further illness and retardation. The large proportions of young people, particularly those who are unemployed or have little hope for a satisfactory future, can form a disruptive and potentially explosive political force.

Only within the last few years, when the vastly accelerated rates of population growth have become apparent to all, have governments recognized the needs and the possibility of actions to protect their people from the consequences of their own fertility and to limit their birth rates. Over a billion births will have to be prevented during the next 30 years to bring down the world's population growth rate from the present 2 percent per year to an annual rate of 1 percent by the year 2000. The task may well be the most difficult mankind has ever faced, for it involves the most fundamental characteristic of all life—the need to reproduce itself. An unprecedented effort is demanded of opinion leaders, planners and community workers, yet success will depend on the private actions of hundreds of millions of individual couples.

[Excerpted from Rapid Population Growth: Consequences and Policy Implications, Volume I. Baltimore (Md.): The Johns Hopkins Press, for the National Academy of Sciences, 1971, pp. 2-7.]

Family Planning Programs in Developing Countries

Theodore K. Ruprecht and Carl Wahren

[A review of family planning programs in developing countries examines their current activities and the important role of foreign assistance by private foundations and governments. Their impact on population trends is estimated, and some problems of future effectiveness are considered.]

The problems posed by rapid population growth have led to active population policies designed to reduce that growth in an increasing number of countries. The Organization for Economic Cooperation and Development (OECD) Development Center sent a questionnaire to administrators of national family planning programs asking what forces had triggered this policy response in their countries. Their answers consistently emphasized the role of economic planners in recognizing the degree to which rapid population growth constrained the ability of the economy to reach its growth targets. Education Ministers were commonly mentioned as a source of impetus towards recognition of the desirability of restoring a demographic balance as they wrestled with the added educational strain imposed by accelerating school-aged populations. Concern for the health of mothers and children has also been a very important factor.

Broadly speaking, government-sponsored family planning grew out of socio-economic considerations in Asia, and to a lesser extent Africa, while due to religious and other related factors medico-humani-

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tarian motives have so far dominated the Latin American scene. In certain cases, foreign advisors who brought the implications of population growth to the attention of the competent authorities were an important element. The development of a voluntary birth control policy was facilitated in several early cases by surveys which clearly showed that a large proportion of the people wanted smaller families and wanted family planning information. In examining the characteristics of underdeveloped countries having a favorable position on family planning, Bernard Berelson recently noted that a developing country with a large population, a comparatively high level of education and per capita income, a high population density and a continuing rapid population growth, would represent the most eager family planning client.

During the 1950s, numerous voluntary groups were formed in developing countries to spread the family planning message and to provide clinical services on a pilot basis. Government-sponsored voluntary family planning first began in India in 1952, but it was not until the early 1960s that other governments made family planning a national policy. The movement has since spread to cover most countries in Asia and a number of nations in Africa and Latin America. Today some 30 governments in the developing world have adopted family planning as an official state-sponsored policy. In about 30 other less developed countries the authorities accept the family planning work carried out by voluntary groups. Some 90 percent of the Asian population (including Mainland China) live in countries with established family planning policies and service programs, while corresponding figures for Africa and Latin America amount to 20-25 percent.

The vast majority of the operational national programs are administered by Ministries of Health, and are usually closely related to the maternal and child health structure. In a few cases (e.g., Malaysia, Pakistan) separate governmental bodies have been set up to administer family planning services. Whatever the administrative form, close interministerial and interdisciplinary cooperation has proved essential to ensure the high level involvement of ministries dealing with education, labor, agriculture, community development and the like. Experience has further demonstrated the importance of giving the leaders of the national population programs the highest possible administrative status.

Institutionalized family planning aims at providing couples in the reproductive age-group with information about responsible parenthood and access to contraceptive services. Programs differ widely depending upon national policies and the degree of government involvement. There seems to be a rapidly growing awareness, however, that the provision of clinical services is not sufficient per se to realize the targets set for a decrease in fertility. Intensified efforts are therefore taking place to spread the notion of the happy, well-fed and

well-educated small family with only two or three children. This implies the gradual build-up of major educational and informational campaigns which involve several ministries. The complexity of a national, well integrated family planning program—covering permanent and mobile clinical services, information campaigns, training of staff, research and evaluation—suggests that the Ministry of Health may not always be the ideal choice for coordinating the activities.

Resource Inputs in Family Planning

Table 1 indicates the magnitude of personnel and monetary inputs of national family planning programs in 1969. Because of the large absolute numbers involved, the Indian and Pakistani programs are listed separately. In per capita terms, the personnel input represents something on the order of one full-time equivalent family planning person per 10,000 population for the countries listed. The budget figure represents $0.10 per year per person—about the same as an ice cream cone. Using the rule of thumb for the proportion of married women in the reproductive ages, the average figure becomes $0.60 per head.

Table 1: Resource Input: Selected National Family Planning Programs, 1969

Program	Personnel Resources 1969				Financial Resources Fiscal Year 1968/69
	National Program		Affiliated Program		
	Full Time	Part Time	Full Time	Part Time	Budgets in $1,000s
India	44,584		N.A.	N.A.	41,190
Pakistan	3,381	37,475	115	51,610	22,397
Other	3,424[a]	5,155[a]	527[a]	3,123[a]	8,258[b]
Total					71,845

a/ Includes Ceylon, Jamaica, Kenya, Korea, Malaysia, Mauritius, Morocco, Nepal, Singapore, Trinidad and Tobago, Tunisia and Turkey. Current data were not obtained for Chile, Colombia, Iran, Taiwan and the United Arab Republic.

b/ Includes Jamaica, Korea, Malaysia, Trinidad and Tobago, and Turkey. Several programs had to be excluded because budgets did not show the family planning component separately.

SOURCE: Questionnaire on National Family Planning Programmes, OECD Development Center, 1969.

One feature of the financing of most of these programs is the high proportion of foreign assistance. In countries where a separate family planning budget exists or can be discerned, we calculated the amount of the total budget (either 1968 or 1969) which came from foreign sources in either local currency or foreign currency, including the value of supplies and equipment. The percentages of foreign sources are 14 percent for India, 34 percent for Korea, 29 percent for Malaysia, 47 percent for Trinidad and Tobago, 68 percent for Pakistan and 75 percent for Mauritius.

The Role of Foreign Assistance

International assistance in family planning began in the early 1950s when private organizations, most prominently the International Planned Parenthood Federation (IPPF), the Ford Foundation, the Population Council and the Pathfinder Fund started providing support. In 1958 Sweden, through the Swedish International Development Authority (SIDA), became the first government to engage directly in operational family planning assistance. Since then a number of other private groups and foundations, governments and international organizations have made family planning assistance an integral part of their overall foreign aid programs. In the last two decades, international aid has been essential in creating a general climate of opinion favorable to family planning, in forming and supporting private voluntary groups, in assisting the clinical training and research activities necessary in initial stages before official local support was obtained, and in advising and assisting governments in the formulation and execution of national population policies.

Despite recent attention to family planning by the United Nations, the World Bank and a few donor governments, it is the major American foundations and the IPPF that have all along provided a very substantial part of the total resources going into the field (see Figure 1). Indeed, for the first ten years they were practically alone. Until recently government assistance has been sparse, and even today it is very limited in the number of donors. This is not surprising; few governments in the West have ever supported voluntary birth control in their own countries. If anything, the private family planning associations in most industrialized countries probably encountered more hostility and ignorance from their own authorities than was later experienced in other parts of the world. International assistance to family planning is, of course, extended in response to specific requests by national governments or private associations in recipient countries.

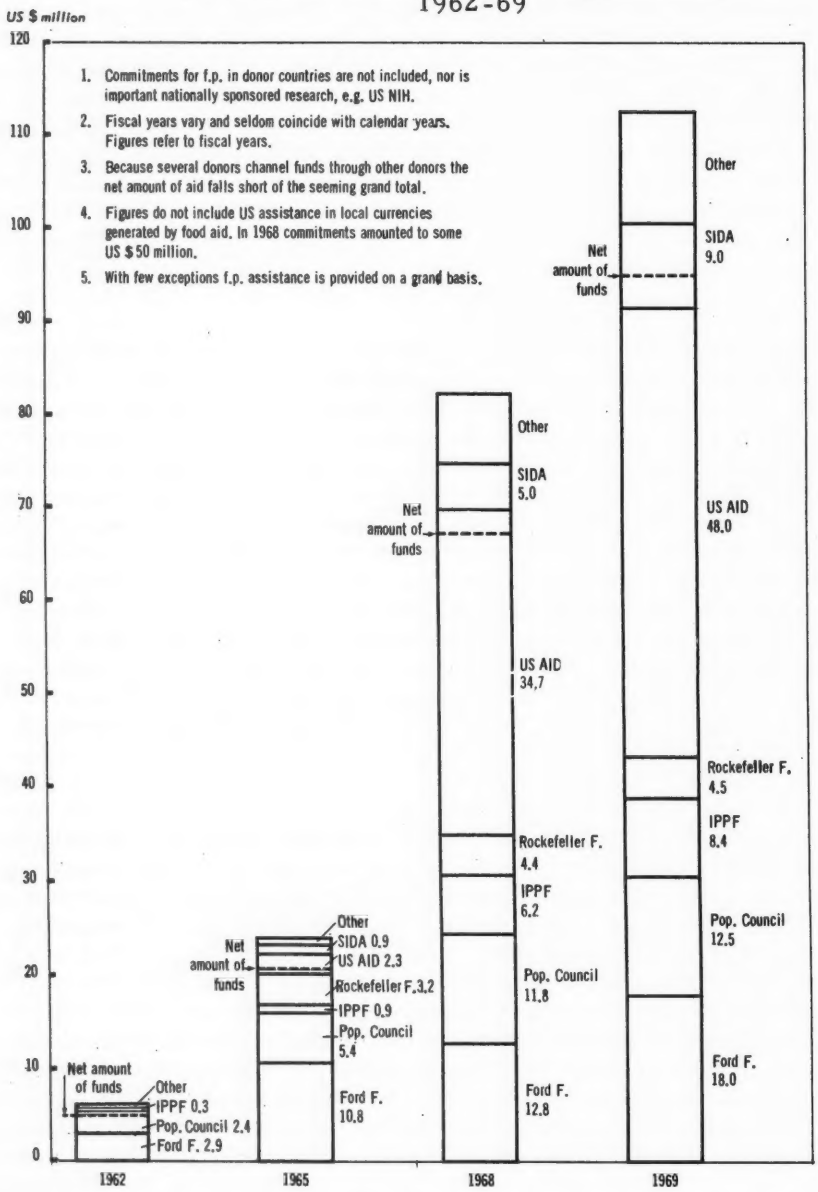
Foreign assistance in this field grew very rapidly in the late 1960s, and support on a large scale is a very new development. In 1962, less than $5 million of overseas aid went into family planning. By 1965 it had risen to some $20 million. In 1968, approximately

$70 million were committed for family planning assistance purposes, and the estimate for 1969 was $95 million. Figure I presents a breakdown of this assistance by major donors. The rapid increase and growing importance of the United States Agency for International Development (AID) assistance is the most striking change; the Figure excludes U. S. local currency assistance generated by food aid—about $50 million in 1968 commitments. (The dotted lines labeled "Net amount of funds" are arrived at by deducting the double counting which occurs in commitment figures because one agency contributes to other agencies. Our studies indicate that disbursements for calendar 1968 amounted to $42. 5 million compared to the $70 million for net commitments shown in the figure; the chief difference between disbursements and commitments is accounted for by AID.)

A total of about 400 professional people on the donor side take part on a full-time basis in this international collaboration. In addition, some 200 members of the United States Peace Corps are serving within family planning programs in Africa, Asia and Latin America. In seven major recipient countries, operational activities constitute the largest single use of foreign funds in four countries and contraceptive supplies in the other three. Research, training and information and education are much smaller users because of their rather modest size in toto; however, foreign assistance in research and training accounts for very large percentages of the total financing of these activities. The use of aid for contraceptive supplies is the most variable category, both as a user of funds and in the relative importance of foreign aid; by and large, it is highest in the smaller and younger programs. The relatively high proportion of foreign funds for operational activities, ranging up to 62 percent in Pakistan, may be surprising to some.

A changing role of foreign assistance can be expected as programs mature and their needs change. One might anticipate, for example, an increasing emphasis upon research and evaluation, a decreasing emphasis upon training, and a lessening dependency on foreign resources for operational activities. In fact, a secular decline in the ratio of foreign to domestic resources might be a rough guide to the progress of the program. Family planning assistance does not replace the needs for other forms of development aid. The competition for funds which is most often suggested is that between family planning assistance and aid in the field of public health. It may well be that donors have sometimes focused too narrowly on family planning in the past. To show greater concern for public health problems in general, and maternal and child health in particular, would probably have a positive psychological impact and could well turn out to be one of the most effective ways of "marketing" family planning and bettering the results so far achieved.

Figure 1: Volume of International Assistance in Family Planning by Major Donors (Commitments) 1962-69



The Quantitive Impact of Family Planning

The most straightforward criterion of the success of a family planning program is a reduction in the number of births from what the

number would have been in the absence of the program. Thus, an obvious technique for evaluation which immediately suggests itself to the layman would be an examination of the trend in the crude birth rate. This "obvious" procedure must, however, be used with great caution. In Hong Kong, for example, the crude birth rate declined from 35.5 per thousand in 1961 to 21.3 in 1968. But the 19 percent decline from 1961 to the 1965 rate of 28.8 was almost entirely (90 percent) due to a reduction in the relative number of women in the most fertile age groups and to a reduction in the proportions married at these crucial ages, and not due to a fall in fertility at all. The 26 percent decline from 1965 to 1968 is, on the other hand, almost wholly due to reductions in marital fertility. It is perhaps significant that this latter decline is consistent in time and age pattern with the family planning activities after 1964; some of the earlier decline which stemmed from delayed marriage might also be attributed to the family planning campaign, which deliberately tried to change early marriage patterns.

When we ask how many births have been averted as the result of a program, we face difficulties with both parts of this question, i.e., the number of births which have been averted, and the number of averted births which are due to the program. One approach is to estimate the difference between the expected number of births and the actual number of births in the population. The method used in evaluating the impact of the Taiwan program was trend analysis of the birth rate. The birth rate decline of 2.3 percent per year from 1951 to the beginning of the program in 1964 was used as an estimate of trend. From 1964 to 1968 the birth rate fell from 34.5 to 28.8 per thousand, an annual decrease of 5.4 percent. It thus appears that the program resulted in an acceleration of the decline by 3.1 (that is, 5.4 minus 2.3) percentage points per year. However, due to the small size of the 1964 program and the nine months gestation period, no significant impact could have occurred in 1964; if we include the 1964 birth rate in the pre-program period and recompute the trends, we find a pre-program decline of 4.0 percent per year and a program advantage of only 1.5 percentage points. In a similar method used to evaluate the Singapore program, "expected" single year rates of age-specific fertility were calculated on the basis of pre-program trends in these rates and used to estimate expected births; differences between actual and expected births were considered attributable to the program.

One of the problems with these approaches is that a family planning program receives credit for all new contraceptive acceptors, and those who improve their contraceptive efficiency as a result of switching techniques or increased motivation, whether or not these were actually related to program actions. The program is also credited with any intensification of the effect of the other socio-economic determinants of fertility, e.g., an increasing rate of female labor force participation. An evaluation technique which escapes from the weakness of having unquantified family planning as the only indepen-

dent variable is multiple regression. A multiple regression fertility model which included quantified family planning as one of the several independent variables was developed for Taiwan; it shows that family planning activity, as measured by lagged man-months of effort, had a small but statistically significant impact upon the adjusted birth rate. Unfortunately, few countries have the data required for this kind of analysis.

For a global assessment of the impact of family planning activities in underdeveloped countries including those where data are sketchy, it is appropriate to attempt an approximation of the magnitude of impact based on levels of program activity. In order for a program to produce a decrease in the birth rate it must achieve the intermediate step of getting fecund couples protected, and we therefore estimate the increase in the number of protected fecund couples. We have assembled the figures on new acceptors by type of contraceptive from the major national and private family planning programs in underdeveloped countries (Table 2). We recognize that statistics from service records must be viewed with caution because of their inherent upward bias, but we have accepted them at face value in what follows.

Table 2: New Acceptors by Contraceptive: Institutionalized Family Planning, Underdeveloped Countries, Recent Years

Country or Region	Contraceptive Method														
	Sterilization in 000					IUD in 000				Pills in 000			Conventionals in 000		
	1964	1965	1966	1967	1968	1965	1966	1967	1968	1966	1967	1968	1966	1967	1968
India	318	487	801	1,602	1,709	610	885	729	526		1	7	494 (5)	473 (5)	755 (5)
Korea	26	13	20	20	16	226	392	323	263		0	76	134	153	136
Pakistan		1	29	152	416	38	483	671	865		0	0	639 (5)	1,327 (5)	1,699 (5)
Taiwan		13(4)	13(4)	13(4)	13	99	111	121	124		28	36		N.A.	
Latin America (1)				1	1	23	77	146	136	42	62	113	3 (6)	1 (6)	2 (6)
Others (2)		11	15	21	26	73	125	166	211	33	89	248	46	61	65
Total (3)	344.6	524.8	877.9	1,807.2	2,179.8	1,068.5	2,073.3	2,157.0	2,125.3	75.3	179.8	479.7	182.9(7)	215.3(7)	203.8(7)

(1) Excludes the Carribean. Includes Argentina, Brazil, Bolivia, Costa Rica, Colombia, Cuba, Chile, Dominican Republic, Ecuador, El Salvador, Guatelama, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Urugey, Venezuela. Annual allocations were made for Bolivia, Dominican Republic, Cuba, Peru and Uruguay for IUD's and Pills from 1965-68 totals, on the basis of the yearly pattern in Latin America net of Colombia and Chile.

(2) Barbados, Ceylon, Jamaica, Kenya, Malaysia, Mauritius, Morocco, Nepal, Singapore, Trinidad and Tobago, Tunisia, Turkey, United Arab Republic.

(3) Independently summed before rounding.

(4) Literature implies constant.

(5) Stock figure calculated from distribution data.

(6) Known to be underreported.

(7) Net of India and Pakistan stock figures.

Sources: Questionnaire on National Family Planning Programmes, O.E.C.D. Development Centre, 1969, Maria L. Garcia, Informe Sobre El Estado De Los Programas De Planificacion Familiar En America Latina, 1968, Centro Latinoamericano De Demografia, Serie A, N° 97, Santiago de Chile, Octubre de 1969. Population and Family Planning Programmes: A Factbook, Population Council and International Institute for the Study of Human Reproduction, 1970.

The number of protected fecund couples is not equal to the sum of new acceptors over the same time period because of two phenomena: 1) not all couples accepting contraception persist with its practice, and 2) as females age their reproductive capacity declines. In most cases the onset of sterility is imprecisely recognized, so that contraceptive use continues but it ceases to have a reproductive impact. To calculate the numbers of protected fecund couples it is necessary to

determine the joint probability of a contraceptor continuing contraceptive practice and not becoming naturally sterile.

We have carried out the required calculations for each contraceptive separately. For sterilization, we conceive of the proportion who continue practicing as those couples which are not broken through the death of either or both partners, and we have chosen an annual proportion, 0.9809, reflective of Indian and Pakistani levels. These rates vary considerably with age; we have used the age distribution from India of women who have themselves been sterilized plus those whose husbands have been sterilized (the Indian program accounts for large proportions of total sterilizations). Continuation rates for IUDs (intra-uterine devices) are complex functions of such variables as the age and parity of the female, the time period between delivery of last birth and IUD insertion, and the amount of briefing provided by the inserter. We have chosen to use a common set of rates derived from the rates for India, Korea, Pakistan and Tunisia, covering a range from 80 percent continuation after six months down to 39 percent 42 months after acceptance. A common set of continuation rates for pills was also used, based upon evidence from India, Korea, Mauritius and Puerto Rico. They range from 65.5 percent continuation after six months to 30.5 percent after 30 months. Conventional contraceptives raise a different sort of estimation problem; continuation rates should only be applied to the flow of new acceptors and not to the total flow of materials to new and old users. The continuation rates for condom users from Mauritius were adopted, namely 0.48 for six months, 0.29 for 18 months and 0.21 for 30 months.

Table 3: Potentially Fecund Contracepting Couples From Institutionalized Family Planning Activity 1964-68

Year Ending	Number by Contraceptive in 1,000s				
	Sterilization	IUD	Pills	Conventional Contraceptives[a]	Total
1965	829	838		N.A.	
1966	1,643	2,249	48	1,134	5,074
1967	3,321	3,364	150	1,800	8,635
1968	5,279	4,185	411	2,454	12,329

a/ Indian and Pakistani user totals plus new acceptor continuers.

Table 3 presents the number of potentially fecund contracepting couples resulting from institutionalized family planning activity from 1964 to 1968. Sterilization contributed 32 percent of total coverage in 1966, increased its role to 38 percent in 1967 and 43 percent by the end of 1968. The IUD percentage has fallen from 44 percent in 1966 to 34 percent by the end of 1968. The Table indicates a very rapid growth in total numbers; this high rate of increase was, of course, from a very small base.

Future Prospect

The foregoing estimate demonstrates that, despite the recent increases in numbers, current levels of institutional family planning activity are still having only marginal effects on the total populations involved. The key question is the degree to which this level of impact can be sustained and increased.

The impression given by a current review of programs is one of an apparent loss of momentum. This is due to a variety of factors, and can be documented by reference to: the standstill status of several programs at their initial stages; the slowdown in the growth rate of such a numerically important program as India's; and the unsteady trend of activities in such a "success" program as Korea's. In India the numbers of new acceptors of sterilization, IUD and pills decreased by 14 percent in 1968/69 after annual increases of over 30 percent in preceding years. In Korea, the family planning budget has increased by only 5 percent since 1966, while the health budget rose by 100 percent and the national budget by 130 percent; and family planning activities in 1967/68 were somewhat below 1966 levels, followed by modest expansion in 1969. However, it should be noted that budget and personnel targets for family planning in plans for the 1970s, in countries where these are defined, show projected increases, especially in the case of India.

In drawing conclusions about the adequacy of program growth rates, two phenomena which will require an acceleration in pace must be noted. The first is the rapidly growing size of the female groups in the reproductive ages. In Taiwan, for example, the number of women 15-49 will increase in seven years by 29 percent from the current 3 million to almost 4 million in 1975. These will be concentrated in the ages of highest fertility; the number of women 20-24 will increase more than 78 percent. It is feared that the fall in the birth rate may be halted, since the younger women are the least interested in family planning and the older group are already being skimmed of much of their "cream" in the sense that a large percent of them have already accepted or tried and rejected contraception. Taiwan illustrates how, as a result of rapid population growth in the past, the absolute number of women which must be reached by a family planning program is substantially increased.

The second phenomenon is the imperfect continuation rates for contraceptors. In order to maintain a given increment in the number of participants in a program the number of new acceptors must grow rapidly, because as the program builds up the dropout rates produce larger and larger numbers of former practitioners no longer using contraception who have to be replaced. It can be estimated that in order to recruit a constant 100 additional participants per year, 122 acceptors must be reached in the first year, 158 in the second, 196 in

the third, 233 in the fourth and 270 in the fifth year assuming a monthly survival rate of 0.97. The effect of these two phenomena is a situation which requires a greater and greater effort to keep the same absolute level of impact on the number of couples protected or on the birth rate. And if family planning programs are to move the world very far through or significantly hasten the demographic transition, a greater effort than even this must be achieved. How large this effort must be depends upon national rates of growth in the number of reproductive women, the rate of discontinuance, the level of current protection and the time period allowed for the transition, i.e., the rate of spread of contraceptive coverage.

It is important to realize, first, that the only cases where family planning programs can be shown to have had an apparent impact on the birth rate are in those countries, such as Taiwan, Korea, Hong Kong and Singapore, where a downward trend in fertility had already begun. Second, even in these "successful" programs the age and parity distribution of acceptors is such as to indicate that family planning is used by couples who already have large families and may, therefore, be highly sensitive to incremental births. For example, in Korea, only 27 percent of women accepting an IUD had less than three living children and 32 percent had five or more. Thirdly, it appears that in many cases there are significant numbers of contraceptive users prior to the beginning of national programs, though the form of contraceptive practice is often inefficient.

Experience with the acceptance and spread of behavioral change in other areas, e.g., agricultural innovation in seeds and the adoption of new techniques of production, indicates an "s" shaped pattern of acceptance in which an initial period of slow acceptance is followed by a period of rapid and then by a concluding period of slow adoption as saturation is approached. The crucial question is, of course, how early in the life cycle of adoption this saturation or slackening occurs—i.e., after what percent of the relevant population has become users of the innovation. This is a question of how resistant and how large is the group of innovation avoiders. On the other hand, there is probably a take-off point, a point at which acceptance is sufficiently widespread to have changed the psychological and cultural climate of adoption and produced a situation in which social change is self generating. The problem faced by family planning programs may be thought of as a race between this saturation range and the take-off point. If the saturation or momentum-loss point is less than the take-off point, the program encounters diminishing returns short of required levels, and the country finds itself in a demographic trap which produces excessive population growth largely beyond the control of a family planning program.

[Excerpted from Population Programmes and Economic and Social Development. Paris: Development Center, OECD, 1970, pp. 39-41, 45-52, 57-64 and 66-70.]

The Impact of Population Growth on National Economic Development

Theodore K. Ruprecht and Carl Wahren

[Theoretical and empirical analyses of the effects of rapid population growth upon the performance of a total economy show that a reduction in fertility can make significant contributions to the development process. These contributions become increasingly important after 15 to 20 years.]

A number of economic growth models have been designed to explore the effects of different trends of fertility upon economic development and per capita income. The models are dynamic simulations in which various predetermined population projections work through capital-output ratios or production functions to yield output projections. The models differ in the number of parameters through which population affects the growth process, the level of disaggregation, and the conceptualization of the behavioral relationships. Generally speaking, population is visualized as influencing economic growth through its effects upon the basic economic inputs of land, labor and capital. The supply of utilized agricultural land is influenced by the pressure of population upon the extensive land margin. Employment is influenced from the supply side by the size and growth of the working-age population, and from the demand side by the level of employment-generating investment in the non-agricultural sector and by the supply of land in the agricultural sector. Investment is, in turn, affected by the impact of population upon the saving-consumption decisions of households, governments and business. [The extent to which large family size reduces national savings is examined in pp. 23-28 below.] In addition, population is seen to play a part in shaping the composition of investment via its role in determining

Preceding article also by Dr. Ruprecht and Mr. Wahren.

the demands for investment in non-productive uses, e.g., schools and houses, rather than in directly productive equipment.

Table 1: Population - Economic Growth Simulation Comparisons

Per capita income under declining fertility as a percentage of that under constant high fertility.

Model	Country	After 10 Years	After 20 Years	After 30 Years
Coale & Hoover	India	103	113-116	138-148
Hoover & Perlman	Pakistan		114-120	
Ruprecht	Philippines	104-105	117-132	135-193
Newman & Allen	Nicaragua	105	115	125
Enke ("Fewer Births")	General	109	119	129
		15 years		
TEMPO ("Pop. Growth")	General	111		136

SOURCES: Ansley J. Coale and Edgar M. Hoover, Population Growth and Economic Development in Low-Income Countries, Princeton University Press, Princeton, 1958.

Edgar M. Hoover and Mark Perlman, "Measuring the Effects of Population Control on Economic Development: Pakistan as a Case Study," Pakistan Development Review, Vol. 6, No. 4, Winter 1966, pp. 545-566.

Theodore K. Ruprecht, Population and Economic Development in the Philippines, unpublished.

Peter Newman and R. H. Allen, Population Growth and Economic Development in Nicaragua, Robert R. Nathan Associates Inc., Washington, D.C., 1967.

Stephen Enke, Raising Per Capita Income through Fewer Births, TEMPO, General Electric Company, Santa Barbara, California, March 1967.

Population Growth and Economic Development Background and Guide, prepared for the Agency for International Development by TEMPO, General Electric's Center for Advanced Studies, Santa Barbara, California.

Table 1 presents the results of these models in terms of the per capita income advantage of reducing fertility as compared with constant fertility. The results obtained from the various models, including those derived from data on actual trends in four different countries and two simulations designed as generalized models for developing

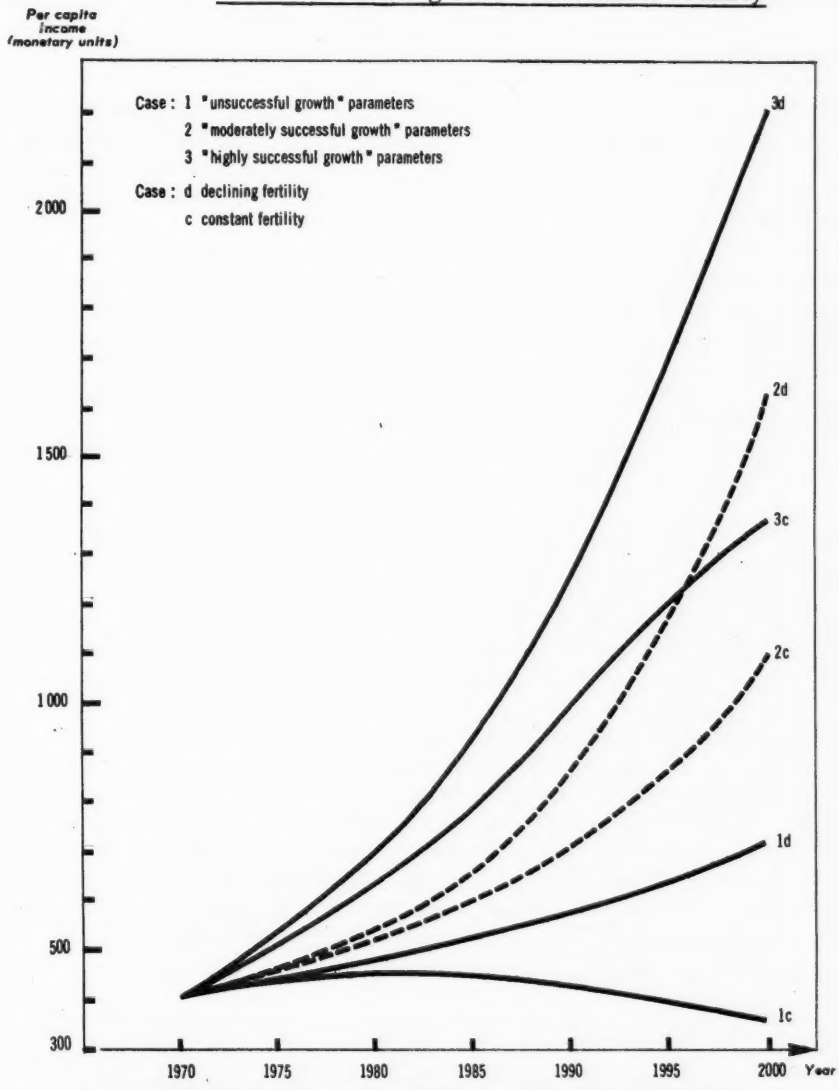
countries, are quite consistent. The gains from fertility reduction amount to a per capita income advantage of approximately 3-5 percent after 10 years, 15-25 percent after 20 years, and 25-50 percent after 30 years. This shows that population growth is an important development variable, but that the economic impact is more a long-run than a short-run phenomenon.

Since the economic impact is relatively small in the short run and since economic development plans are also short run, usually five years or less, a tendency exists to dismiss population considerations and fertility control measures as unimportant in economic planning. The danger is, however, that as short-run periods follow one another, the long run is entered without ever having considered population which is an important long-run growth variable. The contributions to per capita income of a lower rate of population growth in the Philippines can be seen from Figure 1 which contrasts the time trend of per capita income under three sets of conditions representing different levels of economic "success:" case 1 when economic and social conditions are "unfavorable for sustained growth," case 2 of "moderately successful growth," and case 3 of "highly successful growth." The "c" and "d" trend lines differentiate the "constant" and "declining" fertility situations in each case. It is apparent that a reduction in fertility makes an important contribution to improvements in material welfare and that the per capita income advantage is fairly constant at all three levels of economic performance. That is to say, the relative income advantage of reducing fertility is approximately the same over a very wide range of economic growth conditions. This is an important conclusion: it means that "successful" economic growth does not weaken the argument for controlling fertility.

Cases 2 and 3 demonstrate that fertility reduction is neither a prerequisite for nor is constant high fertility an absolute barrier to economic development. Sustained economic growth can be achieved in the face of rapid population increase, but only when other economic growth parameters are sufficiently favorable to offset the disadvantage of constant fertility and rapid population growth. The situation depicted by case 1 ("unsuccessful growth") is an especially interesting one. It is the situation in which the values of the growth determining coefficients are not sufficient for sustained economic development in the face of unchecked population increase. The crucial role of fertility reduction in this case can easily be appreciated, since it makes possible a continuing modest rise in incomes under conditions in which they would otherwise fall.

It should be noted that in case 1c, the case of constant fertility, per capita income rises in the initial few periods before the full retarding effect of the accumulating population burden takes hold. It would be unfortunate if this period of rising per capita income was

Figure 1: Population and Economic Growth: Three Possible Economic Growth Patterns Under Declining and Constant Fertility



Source : T.K. Ruprecht, *Population and Economic Development in the Philippines*, unpublished.

interpreted as a sign that a population problem did not exist, since the economic deterioration of the later periods is entirely due to the "population problem" of the initial periods. If fertility reduction is delayed until the onset of economic stagnation or deterioration, the rapid population growth which has occurred will have built into the

population such a growth momentum that the reversal of the economic trend by fertility control or other means will be extremely difficult. The lesson is that fertility control must have a long lead time over the emergence of a "population problem."

Some Trade-Offs

The extent to which growth parameters must be changed in order to offset the disadvantages of unmodified fertility is calculated in the Philippine study on which Figure 1 is based. The following changes were found to individually insufficient to offset the effects of constant fertility:

1) an increase in savings of 15 percent for households, 5 percent for government and 19 percent for business;
2) a reduction by 2/3 in the decline in the employment-generating ability of investment;
3) a doubling from 1 to 2 percent per year in the rate of productivity increase in the non-agricultural sector; and
4) an increase in exports contributing 0.7 percent of the annual required growth rate in agriculture.

Certain combinations were also insufficient; e.g., an increase in savings combined with the change in the employment coefficient, or the increase in non-agricultural productivity combined with the change in employment. Other combinations sufficient to offset the disadvantage of undisciplined fertility include: increased savings and the export boost, increased savings and non-agricultural productivity, and an increase in non-agricultural productivity combined with the export boost. It is possible to offset the cost (in terms of foregone potential per capita income) of rapid population growth by achieving more favorable economic growth parameters, but only at the price of intensifying the already difficult development task. Population expansion hinders their achievement, for example, by increasing the pressure of consumption upon household incomes and thus savings. The failure to reduce fertility, therefore, either results in a loss of per capita income or in an increase in the required development effort.

[Excerpted from Population Programmes and Economic and Social Development. Paris: Development Center, OECD, 1970, pp. 19-25.]

Dependency Rates and Savings Rates

Nathaniel H. Leff

[Income levels are usually considered the main determinants of national savings rates. However, cross-sectional regressions for 74 countries show both savings ratios and per capita savings levels more strongly correlated—negatively—with the percentages of dependents (children and aged) in the population than with per capita incomes. Thus, high fertility and dependency ratios in underdeveloped nations hinder economic growth by curtailing the savings needed for physical and human capital formation.]

Most discussions of the determinants of international savings rates have accorded an important role to the level of per capita income. This view is supported by the observation that the savings-income ratio is usually higher in the rich countries than in the poor, and has received some support from the statistical studies of international savings rates. The cross-section results suggest that with rising income levels in individual countries, aggregate savings rates should rise as well. This has not been borne out, however, by the time-series data for most countries. Per capita income has been growing at annual rates of 1 to 2.5 percent in most underdeveloped countries during the past 15 years; and many of the social and economic changes, such as expansion of the capitalist sector, which are expected to raise aggregate savings ratios have in fact occurred. Nevertheless, savings rates have generally not shown an upward trend.

Demographic Conditions and Savings

The cross-section and time-series savings functions may be inconsistent because the correlation be-

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tween savings/income ratios and per capita income may, at least in part, reflect a connection between savings ratios and another variable which did not change as levels of per capita income have risen. Crude birth rates are an obvious candidate for this "true" variable. Ranging from 34-45 per thousand population in most underdeveloped countries as compared with 17-23 for most of the advanced countries, they are highly correlated with per capita income levels. At the same time, birth rates in the underdeveloped countries have generally not declined in the postwar period.

The idea that demographic factors should be included in the analysis of savings rates is also indicated on analytical grounds. A number of economists have long suggested that birth rates should be inversely related with a country's savings potential. This suggestion is also supported by casual empiricism. A number of countries, e.g., Japan, Luxembourg, Norway and the communist countries of Eastern Europe, with high rates of saving which are "exceptions" to a per capita income-savings ratio model, fit nicely into an approach which includes demographic conditions. Their birth rates are all low relative to their income levels. Although demographic conditions have been suggested by some writers as important determinants of savings rates, this idea has not been in the mainstream of the discussion. Indeed, some studies and textbooks barely mention it, partly because the hypothesis has not been validated by extensive empirical testing. Consequently, it should be worthwhile to see if inclusion of demographic factors does increase our capacity to explain international savings behavior.

The Hypothesis

The notion that high birth rates will constrain saving has two components. First, a prolonged high birth rate will affect a population's age composition, placing a relatively large percentage of the population in the younger age brackets, as borne out in recent demographic experience. Second, the logic of an inverse relation between dependency ratios and savings rates, in turn, goes as follows. Children constitute a heavy charge for expenditure which, in the standard national income accounting framework, is put under the heading of consumption. Because they contribute to consumption but not to production, a high ratio of dependents to the working age population might be expected to impose a constraint on a society's potential for savings.

The three sources of savings are: private household savings, the public sector's surplus on current account, and corporate savings. The hypothesized link between high dependency ratios and low household savings is, as just described, direct. A connection can also be suggested with government revenues, and perhaps surplus, if we assume that taxation is levied out of discretionary expenditure, which in turn is defined as the surplus above a (conventional) minimum per cap-

ita standard of living. Hence, taxation revenues would be lower because the consumption burden imposed by dependents reduces this surplus. There is no obvious reason why the dependency ratio should affect corporate savings; but we should recognize that in countries where corporate ownership is not widespread and most businesses are family firms, the boundary between business and family income is not hard and fast, so that the household consumption constraint imposed by dependents would also affect "corporate savings." Similarly, in many countries, public sector corporations play an important economic role, particularly in large scale activities. These large investments, which in other countries would be financed from corporate saving, may show up under the heading of a public sector surplus or borrowing from household savings.

The hypothesis of a connection between dependency ratios and savings has in fact been supported by econometric studies which included demographic factors: W. Eizenga's work on personal saving in the United States; and a broader study, Franco Modigliani's pioneering analysis on international "private" (personal plus corporate) savings rates. The present work extends the scope of the inquiry to gross domestic savings rates (i.e., including public sector savings). We will also consider 74 countries as compared with the 24 and 36 in Modigliani's samples.

Statistical Estimation

The technique adopted was multivariate regression analysis. The dependent variables employed in the different equations are S/Y, the aggregate domestic savings ratio, expressed in percentage points; and also S/N, the value of per capita savings, expressed in 1964 dollars. (Y = gross national product, S = total national savings, N = population numbers.) The independent variables used are:

First, the level of per capita income, Y/N, expressed in U.S. dollars. The observations for most countries are for 1964.

A second independent variable is the rate of growth of income. The original Modigliani-Brumberg hypothesis suggested using the rate of growth of aggregate income; but preliminary results indicated that the rate of increase of per capita income was much more significant. For this variable, g, the average annual growth rate in the preceding five years, expressed in percentage points, was used.

A third independent variable is D_1, the percentage of the population aged 14 or less. It is a rough index of the dependency burden imposed by children. This has a range of 40-46 percent for most underdeveloped countries, and 24-31 percent for the advanced countries. The retired, older population also constitutes a dependency burden

by being claimants on consumption without contributing currently to output, so an additional variable, D_2 was introduced. This was defined as the percentage of the population aged 65 or older, ranging from 3 to 5 percent in most underdeveloped countries, and 8 to 13 percent in the advanced countries. Demographic, savings, and income data were available for 74 countries: 47 underdeveloped, 20 developed Western countries, and 7 East European communist countries.

Equation (1) in Table 1 shows the parameter estimates resulting from the log-linear regression equation on savings ratios (S/Y) fitted by least squares to the data for 74 countries. Student t-values are presented in parentheses below each coefficient. The results support the hypothesis concerning the effects of dependency ratios on savings rates. The regression coefficients, which in these double logarithmic equations can be interpreted as elasticities, are much larger for D_1 and D_2 than for the other terms, and the D terms contribute more of the statistical explanation. The t-values are all significant above the .025 level, indicating that the dependency variables should be considered statistically distinct variables in the explanation of aggregate savings rates.

Equation (2) in the Table, estimated with the value of per capita savings (S/N) as the dependent variable, gave similar results as well as some additional information. The relatively large elasticity of D_1 and its high level of statistical significance suggest that the studies of savings levels which have shown the overwhelming importance of per capita income are in part picking up the effect of unspecified demographic variables. Another interesting result is the value of the regression coefficient on the per capita income term, which indicates an income elasticity of savings fairly close to unity. The regression coefficients of these equations indicate that, while large income differences (say, between $100 and $1,000 per capita) are associated with appreciable differences in savings rates (in the example given, 100 percent), the effects of higher income appear to be considerably reduced when dependency variables are included in the analysis.

There is, however, an identification problem: can it be assumed that dependency rates are exogenous factors which influence savings rates, or, might not both variables be endogenous, determined perhaps by per capita income? Does the relation on which we have focused link savings behavior and dependency rates, or have we not simply related two of the many elements which constitute the complex of underdevelopment? By partitioning the data and fitting separate equations for the underdeveloped countries and the Western developed countries, we can see whether or not the earlier equations did not simply reflect the high correlation between two of the interrelated features of underdevelopment. The parameter estimates for these subset equations (3) to (6), are presented in Table 1. (The communist countries were too few to justify a separate regression.)

Table 1: Parameter Estimates for Savings in 47 Underdeveloped Countries, 20 Western Developed Countries and 7 East European Communist Countries

(t-values are in parentheses)

Dependent Variables	Independent Variables				$\bar{R}^2$	F
	log Y/N	log g	log D_1	log D_2		
All 74 countries						
1. log S/Y	.1596**	.0254**	-1.3520**	-.3990**	.5697	25.1604
	(2.8776)	(3.2792)	(4.6406)	(2.5623)		
2. log S/N	1.1486**	.0265**	-1.3438**	-.3966**	.9559	396.677
	(21.5100)	(3.5592)	(4.7916)	(2.6461)		
Underdeveloped countries						
3. log S/Y	.1291*	.0227***	-1.1197***	-.4455***	.2419	4.6685
	(1.8487)	(2.8079)	(2.7636)	(2.1554)		
4. log S/N	1.1167***	.0239***	-1.3122***	-.4469***	.8975	101.6727
	(16.8355)	(3.1204)	(2.9400)	(2.2783)		
Western developed countries						
5. log S/Y	.0035	.2589*	-.4324***	-.4916***	.4395	4.7245
	(.0296)	(1.6228)	(1.7099)	(2.6547)		
6. log S/N	1.0049***	.2591	-.4300*	-.4914***	.8413	26.1798
	(8.3684)	(1.6208)	(1.6966)	(2.6477)		

* significant above the .1 level
** significant above the .05 level
*** significant above the .01 level

The results indicate differences between the two sets of countries. In fact, application of the Chow test of covariance indicated that the developed and the underdeveloped country savings behavior belong to different regression structures. Within both groups of countries, however, the relation on which we have focused remains true. The dependency variables are statistically significant, and their regression coefficients indicate that they are quantitatively more important than the income terms as a determinant of aggregate savings ratios. In the equations for the level of per capita savings, the regression coefficient on the per capita income term continues to indicate an income elasticity close to unity, slightly above for the underdeveloped countries and almost exactly one for the developed countries. Thus the subset results confirm the general pattern of savings behavior.

Analytical and Policy Implications

The results were reached with the fairly simple reasoning outlined earlier, and with relatively crude data and methodology, but they clearly have implications for the theory of savings. For ex-

ample, one way to conceptualize the findings might be to posit a model in which individuals maximize a utility which is a function of consumption, present and future, and of children. Considering the limited availability of contraceptive knowledge and devices, this would not be realistic as a universal description of behavior. However, the model suggests that the high birth rates and dependency ratios in most underdeveloped countries may entail a sub-optimal allocation of resources in that children are born to parents who might prefer not to have them born but who are thereafter committed to supporting them with resources diverted from other uses.

The cross-section results are also consistent with the hypothesis that favorable demographic conditions have been one of the important factors which made possible the high savings ratios of the East European communist countries. Since birth rates in those countries (with the exception of the U.S.S.R.) had reached relatively low levels before the communists took power, this raises a question as to whether the special institutional features of these regimes are a sufficient condition for achieving high savings rates in underdeveloped countries.

This paper indicates that high rates of population growth constitute a two-fold barrier to economic development. On the one hand, a growing population increases the volume of development expenditure needed to raise capital-labor ratios. Our results indicate that through their effects on dependency ratios, high birth rates also limit an economy's ability to respond to these additional needs for savings and investment. The effect of the dependency burden is clearly seen in its diversion of resources from physical capital formation, but large family size also affects human capital formation. Sufficient resources may not be available for improving the quality of human resources by investments in training and education, so a large dependency burden may lead to an economically sub-optimal abundance of raw labor, relative both to skilled manpower and to the physical capital stock. Such a situation is, in fact, recounted of many underdeveloped countries. All these conclusions may be interpreted to warrant expanded policy efforts to lower birth rates in underdeveloped countries.

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Family Planning Via the Postpartum Approach

Gerald I. Zatuchni, M. D.

[If more women could be reached with family planning information in the "postpartum" period following childbirth, either in hospitals or in maternal and child health centers, many unwanted pregnancies could be avoided. Motivation for family limitation is high during this period. The benefits would be fewer births and improved health of mother and children.]

Family planning programs are appealing to mass audiences through circulars, group discussion, magazines and radio in many areas of the world. However, the message carried by these general programs usually reaches highly motivated individuals of older age with many children. In any population a substantial number of women—generally highly fertile, possessing little or no education, under 25 years of age and poor—repeatedly start one pregnancy shortly after completing a previous one. Many of them wish to avoid further childbearing but do not know how. Since a large proportion of unwanted pregnancy is probably due to these women, a selective family planning program directed to them could bring significant results.

In the first three months of pregnancy, the woman is mainly concerned with her early symptoms and with whether she will be able to carry the pregnancy through the nine months. Her concerns are with the present, and her future interest in family planning is minor or non-existent. (If the pregnancy is undesired, her thoughts may be about seeking ways of ter-

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minating it.) In the second three months, the woman has become confident that the pregnancy will continue, and during this period she is mainly concerned with plans for her child and with her own physical complaints. In the last three months of pregnancy, the woman is mostly concerned with the actual delivery: Will it be difficult or painful? Will the baby be normal? Will it be a boy or girl? Again, her future considerations are short-run and her interest in family planning not paramount.

However, immediately upon delivery of the baby if one were to ask new mothers the question, "When would you like to get pregnant again?" most would reply "Never again!" This period following termination of a pregnancy may represent her peak of motivation for family planning. If, as usual, nothing is said to the woman or no advice given, her motivation for family planning begins to decrease as the months pass, and in time pregnancy occurs again. This period, called the "postpartum" period for the three months following delivery or abortion, constitutes a significant time during which women can be easily approached concerning future childbearing. Contraceptive education and services can be provided should the woman so desire. This assumes that some supervision of pregnancy and delivery is available.

Extent of Medical Supervision

In how many countries are women seen by physicians, nurses or other health personnel during pregnancy and during the postpartum period? In the developed countries almost all pregnancies and deliveries are supervised. In some urban centers of the developing world, maternity care is largely institutionalized or supervised at home by trained persons. For example, in Caracas, 99 percent of all deliveries are in hospitals; in Hong Kong, 98 percent; in Manila, 78 percent; in Singapore, 78 percent; in Nairobi, 50 percent; and in New Delhi, 35 percent, with an additional 48 percent as supervised home deliveries. In the developing countries where the care of pregnant women has been somewhat neglected, plans are now emerging to establish centers for maternal and child health (MCH). These centers are being established in rural as well as in urban areas. The already existing obstetrical hospitals and maternity clinics would seem to be the most likely and pertinent place for the development of an educational and service system concerned with family planning. In a well organized maternity service, patients can be contacted through the antepartum clinics, while they are in the lying-in period, and when they return for their six-weeks postpartum health visit.

The concept of integrating family planning into the maternity services of a hospital is not new, but this approach to contraception has largely been denied to indigent women. To demonstrate the concept and bring it into focus, the Population Council organized and supported

a program now called the International Postpartum Family Planning Program. The first phase, begun in early 1966, aimed to provide family planning information and services to urban women of low socio-economic status in settings where obstetrical deliveries occur in public hospitals. The program included 26 hospitals in 19 cities in 15 countries around the world. A wide range of cultures was purposely selected in order to demonstrate the universality of this approach. Several major religious groups are included—Hindu, Buddhist, Moslem, Catholic, Protestant, and others. Four hospitals are located in Latin America—in Puerto Rico, Mexico, Venezuela and Chile; eight hospitals are in the Far East and Southeast Asia—in Japan, Singapore, Hong Kong, the Philippines and Thailand; seven hospitals are in the Middle East—in Turkey, United Arab Republic, India, Pakistan and Iran; and seven hospitals are in the United States.

How the Program Operates

The program operation is simple:

1. The participating hospitals inform each delivery and abortion case, by individual and/or group talks supplemented by visual aids and other means, that family planning is possible, safe and effective; that family planning services are available through the hospitals' postpartum service; and that a range of contraceptive methods is available.

2. Those women who do not return for the postpartum health checkup, particularly those who had expressed an interest in family planning, are followed up by mail, phone, and/or personal visits, as appropriate, by a social worker or equivalent person.

3. The services, including such supplies as pills, IUDs, and other traditional methods, as well as the indicated medical follow-up are provided free of charge.

4. Since any such program would almost surely set up an informal network of word-of-mouth communication that would bring others to the clinics—friends, relatives and neighbors—these people are also accommodated and the women in the delivery wards informed to that effect.

The talks are usually given by a trained nurse or trained social worker and, in some cases, by physicians. Patients are seen at the bedside and, if interested, are invited to attend group talks. In many hospitals educational services are provided on an individual basis. In addition to these talks, group sessions are held at the time of the postpartum health visit.

Several programs do not ignore the husband, but provide information, literature, talks and movies to the men while they are waiting for their wives to deliver. Additionally, during visiting hours in five hospitals, husbands are encouraged to attend male contraceptive classes. Seven hospitals even distribute condoms free or at little cost.

Results

In the first 24 months of operation, more than 236,000 women have actually started to practice contraception. In the non-U.S. hospitals, 509,000 women were admitted to the hospitals for obstetrical delivery or abortion management and 43,748 accepted contraception (mostly IUD) before hospital discharge. Additionally, 60,625 women accepted contraception at the time of the six-weeks postpartum visit. Further, 95,831 women not recently pregnant came to the hospitals from the communities and were started on a contraceptive method. Accordingly, the ratio of total acceptors to hospitalized cases is over 40 percent. Follow-up surveys through home visits indicated that 82 percent of the acceptors were continuing with either the first method selected or a substitute method 18 months following initial acceptance.

Analysis of characteristics of acceptors shows that these women are of relatively young age and have few children. Additionally, about one third of the acceptors still desire more children at some future time, indicating that these women have accepted on a basis of family spacing rather than for family limitation. One third of the direct acceptors and one half of the indirect acceptors reported having used some form of contraception in their last year of need, although most methods reported were ineffectual, so that there is a net gain in substituting effective methods for less efficient ones.

Cost analysis indicates that a hospital approach to family planning is at least as efficient, if not more so, than other more general programs. At an approximate direct cost of $1.25 per hospitalized obstetrical/abortion case in the non-U.S. programs, over 200,000 women have accepted a contraceptive method—a cost per acceptor of $3.20. Program planners should consider implementing effective family planning efforts in already existing hospitals or MCH clinics as a first step before proceeding to the more expensive approach of "freestanding" contraceptive clinics.

Pregnancy Hazards

It has been demonstrated that there are definite material and infant hazards when a woman has too many children too frequently. This is particularly so in the developing areas of the world where maternal nutrition is sub-standard. Many studies have shown that pregnancy complications occur with greater frequency in women who have more

than five children. Hemorrhage, infection, abnormal labors, ruptured uterus and death all increase with each subsequent pregnancy after five. The chronic drain of nutritional elements leads to iron deficiency anemias, protein disturbances and other deficiency states. Infants born too rapidly in succession tend to weigh less and have greater nutritional problems, partly due to the lack of adequate breast feeding.

Postpartum Medical Care

Good medical practice dictates that the woman be seen four to six weeks after the termination of pregnancy to make certain that the pelvic organs have returned to a state of "normalcy," and that the stresses of pregnancy have not caused any abnormalities. Additionally, many disorders are masked by the pregnancy and are only discovered at this postpartum examination. Unfortunately, in most developing countries, women do not return to the hospital to receive this essential health checkup. Postpartum return visits average 15 percent in most countries; returnees are mostly women with severe complications, such as infection or bleeding.

Since the institution of the postpartum program, in which women are told prior to leaving the hospital that they can obtain contraceptive services when they return in four or six weeks, postpartum visits have markedly increased. In 14 hospitals the return rates have doubled. Sixty-five percent of women returning for a postpartum visit accepted contraception. All women returning for contraception also undergo a medical examination. Thus, the "wanted" service of contraception leads to the "needed" service—the postpartum health examination.

Expanded Postparum Program

The Population Council, with substantial financial assistance from AID, has begun the second phase of the effort—an expansion to many more hospitals in the same and other countries. The Council sent an inquiry on institutionalized maternity care to qualified informants in 50 developing countries. We were interested in determining the approximate number of births, the extent of supervised maternity care and the level of family planning procedures currently in use at these institutions. Thus far, 38 replies have been received. In most countries questioned, a surprisingly large percentage of births are supervised—20 to 40 percent, and in some even higher. Of course, there are several areas of the world where as much as 90 percent are unsupervised, but this situation seems to be changing as governments begin to expand their maternal/child health services. Where supervision of births exists, it occurs primarily in a few hospitals. For example, in Colombia, the total number of annual births is

780,000 and about one third or them are supervised. About 140,000 births (or 20 percent of total births) occur in only 12 hospitals. Similarly, in Thailand, over 40 percent of all supervised births occur in only 5 hospitals. In Ceylon, 95 percent of all births are supervised, and 65 percent of those occur in 22 hospitals.

An excellent opportunity exists, therefore, to reach a significant proportion of women of reproductive age in many countries through the support of large maternity-family planning services. When this service is provided, women will avail themselves of the offer and inform their friends and neighbors, some of whom can be expected to appear at the hospital for contraception. For example, the Chulalongkorn Hospital in Bangkok, after only one year of operation and without outside hospital dissemination of information, was able to enroll women from 54 of the 71 provinces in all of Thailand.

The expanded program is well underway and will soon include about 200 hospitals in 25 countries of the developing world. The expansion has assumed two lines: 1) enlisting the support of single, large maternity hospitals in "new" countries—for example, Ghana, Nigeria, and Honduras; and 2) the establishment of multi-hospital programs within a country—for example, 18 hospitals in Colombia, 11 hospitals in Venezuela, 22 hospitals in Pakistan and Ceylon, 10 hospitals in Thailand and 50 hospitals in India. Although these hospitals are mainly located in urban areas, the postpartum approach to family planning can later be established in rural areas as well through the organization of primary health centers, rural sub-stations and maternal/child health clinics. By so doing, we can be assured that a systematic approach to potential acceptors of contraception will exist, and women who wish to have contraceptive advice will find the service available. The integration of family planning with maternity care will probably prove to be one of the most effective long-term approaches to the major problem of excess population growth.

[Excerpted from "Family Planning Via the Postpartum Approach," War on Hunger: A Report from The Agency for International Development. Washington (D.C.): U.S. AID, Vol. III, No. 10, October 1969, pp. 12-16.]

Voluntary Sterilization: A World View

Harriet B. Presser

[Sterilization as a method of birth control is practiced on a very limited scale in most countries. Notable exceptions are Puerto Rico, where female sterilization has been quite popular since the early 1950s, and India, where male sterilization has become increasingly popular since the early 1960s. This method can be a medically safe and relatively failure-proof alternative for individuals seeking to end their reproduction. More public education on the subject is needed, as well as more research into causes of resistance to and side effects of the operation.]

Measuring the prevalence of sterilization in different countries is a difficult task. Only a few national surveys include such data and, for those that do, the different sample designs restrict comparability. An alternative to survey data in estimating the prevalence of sterilization is to consider all reported sterilizations over the years and relate the accumulated number to the population in the reproductive ages for the last year in which sterilizations were reported. The basic problem here is that reported sterilizations generally refer only to those performed through national family planning programs; the number of sterilizations performed in the private sector remains unknown. Bearing in mind these limitations, we have compiled various estimates of the prevalence of sterilization, male and female, for countries where such data are available.

It may be first noted that the practice of female sterilization is extremely popular in Puerto Rico.

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Whereas only 7 percent of all ever-married women in 1947/48 were sterilized, this figure rose to 16 percent in 1953/54, and doubled again to 32 percent in 1965. Having a third of all ever-married women (ages 20 to 49) sterilized is clearly unprecedented in any other country, industrialized or developing. Male sterilization, however, is rare.

In Japan, a survey made in 1961 suggests that about 5 percent of all married women aged less than 50 had been sterilized. Male sterilization was less prevalent: only about 1 percent of all married men in Japan aged less than 50 in 1961 had been sterilized. With respect to both male and female sterilization in Japan, it is estimated that roughly 6 percent of all couples meeting the sample description had been sterilized by 1961.

The prevalence of female sterilization in the United States increased from about 8 percent of all married white women aged 18 to 39 in 1955, and again in 1960, to about 11 percent for a similar sample in 1965. Male sterilization in the United States has been less popular, but apparently is also on the rise. In 1955, about 1 percent of the men married to women in the sample were sterilized; in 1960, 2 percent; and in 1965, 3 percent. The combined prevalence of male and female contraceptive sterilization was roughly 4 percent in 1955, 6 percent in 1960, and 8 percent in 1965. It should be noted that these estimates relate to specified samples: white married couples with the wife aged 18 to 39.

Survey data for five cities in Latin America reveal a low prevalence of sterilization, ranging from 1 to 6 percent of all Roman Catholic women aged 20 to 50 in 1963/64, as follows:

City	Percent Sterilized
Bogota	1
Caracas	6
Mexico City	2
Rio de Janeiro	6
San Jose	6

It may be seen in Table 1 that India clearly ranks highest in the prevalence of sterilization among the countries having national family planning programs. In absolute numbers, the figure of 5.2 million sterilizations is enormous; it undoubtedly represents a greater number of sterilizations than performed in all other countries combined. But it represents only about 5 percent of married women aged 15 to 44. This is comparable to the experience of Puerto Rico in the late 1940s, or Japan and the United States early in the 1960s. Similarly, many sterilizations have been performed in Pakistan, Korea, and Thailand, but the numbers represent only about 2 to 3 percent of all

married women in that age group; and the coverage is below one percent in the other countries listed. Again, it may be noted that these are conservative estimates, as sterilizations performed in the private sector are not included.

Table 1: Accumulated Sterilizations Performed through National Family Planning Programs, for Ten Asian Countries, as of January 1, 1969

Country (ranked by number of sterilizations)	*Number of sterilizations (in thousands)*		*Adjusted number of sterilizations per 100 married women aged 15-44*
	Total	*Adjusted*[a]	
India	5,200	4,900	5
Pakistan	597	567	3
Korea (Republic of)	118	112	3
Thailand	123	95	2
Ceylon	12	11	0.8
Tunisia	4	3	0.5
Hong Kong[b]	2	2	0.4
Malaysia	3	3	0.2
Nepal	2	2	0.1
Taiwan	1	1	0.1

[a] Discounting for deaths of sterilized persons and for aging beyond reproductive years. The adjusted figure is thus an estimate of the number of sterilizations serving as effective contraception.

[b] Nonsovereign territory.

Source: Nortman (1969: Tables 11 and 12).

Medical Aspects

Male sterilization (vasectomy) is a simple operation and can be performed quickly in a physician's office or in mobile units. Hospitalization is usually required for female sterilization (tubal sterilization), though mobile units have been used in India. Sterilization, both male and female, is a safe and highly effective birth control method relative to such alternatives as the contraceptive pill, the IUD, or induced abortion. The use-effectiveness of vasectomy is high: recent studies show the failure rates to be within the range of 0.3 percent to 4.1 percent of all vasectomy cases; in all studies combined, the failure rate averages 0.9 per 100 vasectomies. Tubal sterilization is more effective in preventing pregnancies than vasectomy; the failure rates for recent studies range between 0.0 to 2.0 percent. Vasectomy does not appear to have any risk of death; there was not one death from this cause reported in the numerous studies reviewed. There is a low risk of death associated with tubal sterilization; this risk is roughly comparable to that from childbirth in the U.S. Both operations appear to have a similar (and high) rate of morbidity (illness), but complications were generally reported by patients rather than by their physicians, and most complications did not appear to be serious.

The critical medical aspect of sterilization, both male and female, is its finality. Because the operation as currently performed cannot

be successfully reversed in many cases, it must be regarded primarily as a means of ending reproduction and cannot be promoted as a means of child-spacing. There are a number of reports on results of operations to restore fertility after vasectomy, with 60-80 percent rates of success in a few instances; but the numbers of cases reported are small, and success depends on the skill of the physician as well as the technique used for sterilization. A reliably reversible method may never be developed, according to some scientists.

Implications

A fertility decline in a country typically begins with older women wishing to end their entire reproduction earlier; attempts by younger wives to space children follow later. Thus, it may be argued that sterilization is an especially appropriate method of birth control in developing countries that are just beginning their fertility decline—and as part of a family planning program that seeks to initiate such a decline. Sterilization may also be regarded as an appropriate follow-up or back-up method of birth control in developing countries that have passed this early phase and in developed countries, representing an optional method to end reproduction after the desired family size is attained.

Of course, this does not mean that the contraceptive pill, the IUD, and other methods of birth control should not also be available as alternatives. They are preferable in the sense that they are reversible. In some situations, however, sterilization may be regarded as preferable because it is not reversible; the sustained motivation required for the effective use of the pill and other methods of birth control, and the low retention rates associated with the IUD, are not problems with sterilization. It is true that couples may change their minds and wish additional children after sterilization (as a consequence of remarriage, death of children, etc.), but how many do? Follow-up studies of sterilized persons suggest there are not many. It is debatable whether having more children than desired as a consequence of contraceptive failure is preferable to having fewer than desired as a consequence of changing one's mind; the former is certainly more burdensome. In either event, it can be argued that individuals should be permitted to decide this issue for themselves provided they have sufficient information. In many hospitals and family planning programs, however, sterilizations are only made available to persons above a defined age, or having more than a minimum number of children.

We have seen that, despite the high rating of sterilization as a safe and effective means of ending reproduction, it is not widely practiced in most countries. Its timing in relation to the age and parity (number of preceding births) of women, including wives of vasectomized males, is late. This suggests that even if the prevalence of sterilization were

to increase, its demographic effectiveness in most countries would not be great unless there is a concomitant trend toward earlier timing. An important exception is Puerto Rico, where there has been a trend toward earlier timing; sterilization is now having a marked effect on the country's fertility rates. The Puerto Rican experience suggests that, if a large proportion of women are to choose sterilization at an early stage in their reproductive period, there must exist a high degree of motivation as well as the knowledge and availability of the operation.

We have considered the social and economic characteristics of those who chose to be sterilized. Few generalizations could be drawn from the data. The large proportions of illiterate among the sterilized in developing countries suggested that a minimum level of education was not essential to the acceptance of sterilization. We have also found that sterilization is acceptable to those with different religious affiliations, including Hindus, Muslims, and Roman Catholics. In the developing countries, sterilized males or husbands of sterilized females do not seem to be found predominantly among persons employed either in agriculture or in non-agrarian occupations. Lack of comparable data limited our analysis to only these three social and economic variables; more research, rigorously designed, is obviously needed in this area.

The large majority of those sterilized, male and female, seem in general to be satisfied with the operation. There were some differences by country, but the reasons for such variation could not be determined. Also, the large majority of those sterilized, male and female, reported either no change or an increase in sexual desire or activity following the operation; again, differences by country could not be easily interpreted. A large majority of sterilized persons, males and females, reported no change or an improvement in general health following sterilization; and, again, there was considerable variation by country that remains unexplained. It cannot be overlooked, however, that some studies indicated there were substantial proportions of sterilized persons, although in the minority, who were not satisfied with the operation, had negative psycho-sexual effects, or reported that their general health had deteriorated after sterilization. We were unable to assess the extent to which these negative effects were a direct consequence of sterilization, were psychologically induced by ignorance and negative public opinion about the operation, or were attributable to other factors not directly related to the operation. Ignorance and negative public opinion about sterilization are not exclusive to predominantly illiterate populations. There is a definite need for more research in the area of psycho-sexual and physical effects of sterilization that will lend itself to cross-cultural comparisons, and incorporate into the study design control groups of non-sterilized persons.

Clearly, the public in all countries needs to be better informed about the nature of sterilizing operations. An educational effort requires the support of professionals, particularly in the medical profession, but may also be enhanced by the use of mass media and well trained field personnel. Facilities must also be made available; and the standards applied in giving permission to individuals wanting the operation must be flexible—or non-existent—for sterilization to be truly voluntary and represent a real option for persons attempting to control their fertility.

[Excerpted from "Voluntary Sterilization: A World View," Reports on Population/Family Planning, No. 5. New York: The Population Council and the International Institute for the Study of Human Reproduction, July 1970, pp. 1, 7, 10-12, and 32-33.]

Incentives for Fertility Control

Lenni W. Kangas

[In a number of countries money payments have been used to stimulate the adoption of contraceptive methods, and additional forms of financial incentives for reducing births have been proposed. This idea has stimulated much controversy; some of the criticisms have been too narrowly based, and a wider view of the subject is warranted.]

Financial incentives have been given to acceptors of contraceptive methods, to personnel who provide family planning services, or to agent-recruiters who bring clients to service centers. Occasionally a mix of these rewards is offered, as in India, Pakistan and the United Arab Republic. During the brief and relatively limited world experience in the use of incentive rewards to make family planning programs more effective, this innovation has engendered a great deal of speculative discussion and considerable controversy. Some regard an appropriate incentive system as a near-panacea for circumventing the difficulties and frustrations confronting organized efforts to bring down birth rates in developing countries. Moreover, many of the recent proposals strongly reflect the desire to discover the "one best way" or single kind of payment that will prove to be the determining factor in reducing human fertility.

Critics and skeptics, on the other hand, often view incentive-payment systems as Machiavellian mixtures of bribery and coercion, particularly if they are to be applied with sophisticated popularization techniques to an unsophisticated, tradition-oriented peasant popula-

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tion. Ethical questions have been raised as to whether it is proper to interfere so blatantly, or commercially, in the sacred arena of human reproduction, where, these critics maintain, voluntary and individual freedom of choice should remain paramount. Projected costs, vaguely or explicitly justified with calculations indicating that an averted birth is equal in value to several times the per capita income, impress real-life planners and policy makers as exorbitant regardless of the presumed logic of the economic analysis.

Present Incentive Programs

Present incentive programs operate almost exclusively on the individual level with regard both to recipients and to providers, although some incentives for group performance are offered to providers. In India, a man presenting himself for a vasectomy receives a nominal monetary reimbursement to compensate for time lost from gainful labor, for personal inconvenience, and (unofficially) as an inducement to undergo the operation. In many countries, a woman accepting a contraceptive method is financially rewarded and the midwife, nurse-recruiter, or social worker receives a payment for the referral.

Payments to service personnel, for example to physicians inserting intrauterine contraceptive devices (IUD's) are common, and are frequently prorated among other clinic staff as in the United Arab Republic, Taiwan and elsewhere. Agent-recruiters or "canvassers" employed in the vasectomy programs in parts of India and in East Pakistan receive payments on a per capita basis for successful referrals. These "finder's fees" are sometimes shared with "subcontractors," who represent an extension of the authorized canvasser's activity.

Other inducements that fall into a broadly defined category of incentives include free or reduced-price IUD insertions or contraceptive supplies (Taiwan), free transportation or babysitting services (U.S.A.), or state-provided or subsidized abortion and contraceptive services (U.S.S.R. and many Eastern bloc countries). Additional examples could be cited, but these are sufficient to illustrate that all of the incentives used thus far in the vast majority of programs are given to individuals—acceptors or providers, or a combination thereof. Almost no material rewards are offered today for non-birth or for successfully continuing contraceptive practices.

Proposed Incentive Programs

Some characteristics of recently proposed incentive schemes are given below.

1. Annual rewards to married couples of reproductive age who avoid having offspring; the suggested range of payment is $5 to $10

per year (suggested by J. J. Spengler, 1967). Economist-demographer Spengler has recently argued eloquently for a broader social security system of deferred payments to couples who limit their reproduction.

2. Rewards of up to one half the per capita income "each year to each fertile woman who does not get pregnant" (suggested by Julian Simon, 1968).

3. Blocked savings accounts for women who remain non-pregnant for three to four years with verifying examinations conducted thrice yearly; the approximate cost would be $25 to $35 per year in rewards only (suggested by Stephen Enke, 1960).

4. A family planning "bond" offered to couples who accept a specified limit on their family size; the bond would be payable at retirement age or at the end of 20 years, whichever is sooner (suggested by R. G. Ridker, 1968).

5. A range of incentives for vasectomies depending on couples' parity (suggested by E. Pohlman, 1967/68). Larger rewards would go to those who limit family size to two or three; smaller rewards for those with four or more. Community incentives would be offered if a substantial number of men in the village participated.

6. National savings certificates to married women in the reproductive ages who remain non-pregnant for three, four, five or more years, at the rate of about $3 to $4 per year (suggested by Marshall C. Balfour, 1962).

7. The Institute of Rural Health and Family Planning, Gandhigram, India, has developed a proposal (1969) for community incentives related to India's vasectomy program. Community rewards would be channeled through village leaders in an attempt to gain their active support for family planning activities.

The first proposal by Spengler and the suggestion by Simon appear to take inadequate account of the fact that, especially in countries where prolonged lactation is common, an average fertile woman who has recently had a child might not become pregnant again for a period of up to three years or so even if the couple were not using contraceptives. In addition to the high cost associated with Enke's proposal, Berelson and others have pointed out the major administrative problems associated with monitoring non-pregnancy among participants three times a year.

With regard to the family planning bond proposed by Ridker, he himself has admitted that "simple mistrust of the government's

promise to pay" might be a major obstacle. Although the bond proposal may be attractive in terms of cost and possible administrative feasibility, this probable mistrust remains a central weakness. Spengler has also raised the question of whether peasant classes are sufficiently future-oriented and trustful of government bureaucracy to go along with a system of long-deferred rewards administered by the state.

Pohlman's several proposals have evolved to one emphasizing incentives primarily for vasectomies. He has seriously considered additional rewards for group and community participation. As with the concept of community incentives advanced by the Gandhigram proposal, field testing would seem the next logical step. Since both proposals focus on vasectomies, the neglect of other methods is a possible shortcoming, but this may be adequately compensated for by fewer administrative complications as a result of dealing with only one method. Finally, Balfour's savings certificate scheme would require a relatively simple verification procedure certifying that there has been no birth (not non-pregnancy). He also ties it to a system of national or "postal" savings in which villagers already have trust.

Criticisms

Incentive proposals as a genre seem to encounter an unusual amount of skepticism and outright opposition. F. W. Notestein has maintained, for example, that "There is also danger that incentives through bonuses will put the whole matter of family planning in a grossly commercial light. It is quite possible that to poor and harassed people financial inducements will amount to coercion and not to an enlargement of their freedom of choice." Notestein goes on to say, "Family planning must be, and must seem to be, an extension of life, not coercion toward its restriction." Sentiments such as these are widely held today. (Curiously, critics of incentives for acceptors commonly express great concern about corrupting peasant populaces but seldom exhibit the same level of concern about corrupting professional providers, such as physicians, with extra fees.)

In addition to such resistance to the general idea of incentives, most of the particular proposals we have seen thus far have weaknesses which have elicited criticisms in terms of their cost, administrative feasibility, and political or ethical acceptability. It is likely that subsequent refinements or additional proposals will also include shortcomings when carefully examined. There is, however, a tendency to dismiss almost offhandedly the entire concept of incentives before adequate trials have been made, simply because the limited experience with some schemes has revealed certain flaws or occasional abuses, or because the proposals presented to date are less than completely perfect. In addition, population policy makers and family planning officials have too often treated these several ideas

one at a time with almost no attempt to synthesize or modify them into more workable schemes.

These restrictive attitudes may arise because government-supported efforts at reducing human fertility have generally attempted to match the capabilities of an existing bureaucratic apparatus to the task of reducing the nation's birth rate. Family planning programs have become locked into an "input orientation:" government officials have thought, "We have a health ministry with clinics and hospitals, a hierarchy providing administrative control, plus doctors, nurses, and paramedical personnel; now, how can we utilize these available resources to promote the practice of contraception?" The common result is a program that emphasizes a clinical approach—one in which the individual acceptor becomes the focal point of attention. A different approach would begin by focusing on the goal of lowered fertility and then identifying the known or suspected components of population growth that must be changed, restructured, or manipulated to reach that goal. This is essentially what Kingsley Davis proposes when he urges family planners to recognize that "the creation and care of new human beings is socially motivated, like other forms of behavior, by being a part of the system of rewards and punishments that is built into human relationships, and thus is bound up with the individual's economic and personal interests." [See Development Digest, April 1968, pp. 20-29.] Davis advocates changes in the role of women, family structure, and other behavior patterns affecting fertility, although he leaves unsaid how these changes should be wrought. With this wider view of the subject, it becomes possible to consider how administrative methods might be devised, including not only direct emoluments for individuals or groups but perhaps also more indirect sanctions and incentives, which could redirect (or in some cases reinforce) the existing "rewards and punishments" of a given society so that the overall goal is brought closer to reality.

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Family Planning in Africa

Pierre Pradervand

[Tropical Africa has the world's highest birth rates, and there is widespread opposition to the idea of birth control, a result of very high infant mortality and specific cultural traditions. These attitudes will remain for some time, even after mortality declines; family planning could only become acceptable in some areas if introduced cautiously in a maternal and child health context and tied to birth spacing rather than limitation.]

For many years tropical African fertility was frequently characterized as moderate, or at least not extreme. Two recent and excellent studies, summarizing a great deal of recent research, have forced us to change our views on the subject. Demographers have now arrived at reliable estimates enabling them to conclude that the birth rate for all of the populations of tropical Africa combined is 49 per 1,000. This is far higher than any other area of the world. There are regions of low fertility in Africa, but these are confined to numerically unimportant subgroups. According to the World Population Data Sheet for 1970 (Population Reference Bureau), only three small African nations have birth rates less than 40 per 1,000, while the world's highest rates are largely concentrated in Africa. Twelve African countries have birth rates of 50 and over; in Asia, only four countries share this dangerous privilege, and none in Latin America or elsewhere. The average total fertility—i.e., the average number of live births per woman—is around 6.5 per woman in tropical Africa, considerably in excess of any other region of the world. In Algeria, a woman married from 15-45 without in-

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terruption of her fecund life will bear an average of 10 living children—and this excludes abortions, stillbirths, etc.

Attitudes Toward Children

This high fertility seems to have its roots mainly in the socio-economic organization and a still prevailing high mortality rate. It is buttressed by three main causes: children are economically valuable, or at least share the work burden; they provide assistance much needed in societies without governmental social services during old age and sickness; and they add by their numbers to parental prestige. This relationship expresses itself in strongly pronatalist attitudes among the African population in general which come out quite clearly in the comparative study of the African attitude surveys recently made by Caldwell. Questions on ideal family size give extremely high figures, going up to 7.5 in rural Ghana, as compared to 3.5-5.0 in most other developing countries. Even in urban Kenya, the figure is 6.2 among males. The ideal family size is thus usually comparable to or higher than the actual family size, which is generally a little over 6.0. In other words, people express the desire to have more children than they really have. Of 15 surveys listed, the lowest percentage of women wanting 5 or more children is 89, and in eight cases it is between 98 and 100. The percentage wanting no more children nowhere attains 1/3 of the women interviewed, whereas in other developing areas it is currently over 1/2 and occasionally 4/5.

In North Africa, however, surveys have shown that attitudes are more similar to results found in other developing countries. It may thus be useful to compare briefly some aspects of the sub-Saharan cultures with those in other areas. I believe that a certain unique mixture of conditions present only in tropical Africa have so far posed a far more formidable barrier to the diffusion of contraception than elsewhere. For example:

a) In most rural areas of traditional countries there is a strong preference for sons. This means that as soon as a woman has had her quota of boys she will tend tostop conceiving as opposed to a woman who has no marked preference. However, it seems that in many, if not in most African tribes, girls are as welcome as boys.

b) Most cultures have a low regard for illegitimate children, and often they have no legal standing. In numerous African groups on the other hand, the very notion of an "illegitimate" child is ambiguous, and the fruit of such an "illegitimate" union will be joyfully adopted by the father of the girl.

c) Infanticide for economic reasons is almost non-existent in tropical Africa, while it has occurred in numerous other cultures.

d) Sterility is a misfortune, in varying degrees, for women in other areas; in certain African tribes it makes the woman almost an outcast.

e) The traditional African woman is seen first as a potential mother before being considered an object of sexual attraction. This does not mean that physical beauty is unimportant, but it seems to come after the capacity to reproduce.

f) Most cultures have strongly insisted on premarital chastity among women, whereas in many tropical African groups there is great permissiveness toward premarital sex.

These attitudes have deep roots in the social structure and high mortality. It would be a waste of effort to try and change attitudes without trying to change first the social conditions which produced these attitudes, as the failure of mass communication campaigns in family planning in other countries has proved. The notion that one can "sell" family planning with good publicity techniques (just as one sells a deodorant) is totally alien to social reality and to the Africans themselves.

High Mortality

The main reason that any attempt to make populations adopt family planning is doomed to fail in tropical Africa is the high level of infant mortality. In many rural areas, a newborn child still only has slightly more than a 50 percent chance of attaining the age of five. For many regions data are lacking, but the figures from a recent study of African demography indicate that infant deaths as a proportion of live births in ten areas of West and Central Africa are in the vicinity of 25 percent (the range is 16.3 to 34.4 percent). As Cadlwell puts it:

> The greatest influence in creating pro-high-fertility cultures and religions of tropical Africa has undoubtedly been high mortality levels, especially among infants and small children. These cultures were formed and entrenched at a time when possibly no more than half of all children survived to five years of age, no more than four tenths of females reached reproductive age, and little more than a quarter survived to the end of the reproductive period.

Despite the much heralded progress of public health in many parts of this continent, overall mortality in Africa remains high. Etienne van de Walle, a leading demographer, has aptly summed up the situation:

> Our general impression of the course of mortality during the 1960s is one of impressive advances in certain countries, compensated by relapse into higher or even catastrophic mortality

> in other areas, and resulting finally in only slow general progress. Mortality in tropical Africa remains higher than in any other big world region, and the high morbidity contributes to the poor economic performance. The fight against the great endemic diseases has been waged for a long time but nowhere decisively won, even in small geographically isolated Zanzibar where a vigorous malaria eradication campaign is only partly successful.

With such high levels of mortality, might it not be inconsiderate to offer family planning services? Recent studies have shown fairly conclusively that to be certain of the survival of one single son when the father attains 65, a couple would need to have more than seven children in many parts of West Africa. One is never going to convince women to adopt contraception on a large scale as long as mortality levels are so high. There is no example of a successful large-scale family planning program in any country with death rates above 12 per thousand, but in most of sub-Saharan Africa death rates are about twice this level.

In most areas of tropical Africa, the main preoccupation of women is with subfecundity, not contraception. The possible "clientele" for family planning clinics separated from the context of maternal and child health is still probably very small, restricted no doubt to a minority of the upper class urban elite. Policy choices in the field of population control in tropical Africa are thus extremely limited, as E. van de Walle has clearly pointed out:

> It follows that African nations <u>have no real policy choice</u> at least in the short run, on the subject of population growth. They have to work toward improving health and those socio-economic conditions that are related to health and expectation of life (within the constraints of their budget). They have to accept population growth as an inevitable consequence of progress. The important proviso is that they must be committed to a balancing effort toward reducing fertility as soon as possible.

These somewhat chastening conclusions are acknowledged by a growing number of specialists who have some knowledge of African conditions. A unique set of cultural, demographic and socio-economic conditions force one to put aside any preconceived notions as to how family planning will "happen" in Africa; what works fairly well in Tiawan, not very well in India and poorly in Morocco will not necessarily work at all in Dahomey or the Congo.

Government Attitudes Toward Family Planning

The above conclusions are not necessarily valid for the Maghreb where two countries (Morocco and Tunisia) have official family planning programs. A higher level of development, and lower mortality, have at least initiated widespread changes in the attitudes of couples toward contraception, which should make national family planning programs based on maternal and child health centers a worthwhile investment in economic, medical and human terms. South of the Sahara, it is important to make a distinction between the French-speaking and English-speaking countries in this respect. A few of the English-speaking countries have fairly widespread family planning activities, and two (Ghana, Kenya) have official antinatalist policies and a family planning program. Their governments, and some elements of the urban public, are receptive to the malthusian orientation of many Western (or, on occasion, Eastern) advisers and missions.

This is certainly not the case in French-speaking countries. The idea that Africa, or large parts of it, is underpopulated is still widely prevalent in official circles. In countries like the Republic of Congo (1 percent of the agricultural area is under cultivation, huge deposits of various metals ensure a steady source of foreign exchange, and the country has one of the world's largest hydroelectric potentials as yet almost untapped) or the Ivory Coast (one of the fastest economic growth rates of Africa, needing immigrant labor from neighboring countries), not to mention Gabon (highest per capita income of French-speaking countries of tropical Africa, and probably underpopulated due to the lowest population growth rate of all the developing world, 0.9 percent), one can easily understand that politicians and economists think in these terms. What is more, many members of the elite in these countries are openly suspicious of the sudden Western eagerness to help them "control" their populations when there is often so little enthusiasm to help on other more urgent projects.

This desire to do without population control came out clearly in a declaration by President Boumedienne of Algeria who said:

> Our aim, in a relatively near future, will be, in the coming twenty years, to assure that the masses of our people—which will attain the figure of about 25 million in 20 years—will enjoy one of the higher levels of living of the modern peoples of the world of tomorrow. I take this occasion to say—concerning what is called the 'galloping population increase'—that we are not in favor of false solutions such as birth control. We consider that this is simply a way of suppressing difficulties instead of searching for positive solutions. On the contrary, we are in favor of positive and efficient solutions such as the creation of jobs for adults, of schools for children and of better social amenities for all.

Can Something Be Done Now?

Despite widespread opposition to the idea of birth control in most areas of Africa, there seems to be interest among numerous women in the spacing of births. In the traditional, rural, pre-independence society, there existed a natural spacing of births, due partly to the polygamous structure of traditional African society and partly to various customs like the separation of spouses after childbirth. Under the impact of modernization polygamy is on the decrease, traditional customs are shattered, and the unanimous impression of numerous doctors we have interviewed is that this "natural" spacing is breaking down and birth intervals decreasing, thus increasing the frequency of childbirth. Many Western observers think that the concept of "spacing" births is a "modern" concept understood only by "Westernized" women; yet studies undertaken in Algeria prove how erroneous such a position is, and discussions with individuals working in rural areas of Togo have confirmed to us that an interest in spacing exists also among rural women of tropical Africa. Furthermore, in some large cities there is among at least a minority of women a growing interest not only in the spacing of births, but possibly also in their limitation, as evidenced not only by attitude surveys but also by a growing number of induced abortions.

It thus seems that family planning presented as an integral part of maternal and child health would have some chances of success if introduced cautiously and little by little. We consider this the most useful approach to family planning on any large scale in this area, certainly in the French-speaking countries, although some countries like Chad, the Central African Republic, or Upper Volta might not be ready even for this.

[Excerpted from Family Planning Programmes in Africa. Paris: Development Center of the Organization for Economic Cooperation and Development, 1970, pp. 11-18 and 21-26.]

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Abortion in the Demographic Transition

Abdel R. Omran

[Induced abortion seems to be increasing in developing countries where economic and social pressures to reduce births are building up, and further increase is likely. In Japan and eastern Europe, where the operation is legal and medical services adequate, it is associated with sharp declines in fertility and low medical risk; where abortion is illegal, it is a frequent cause of maternal illness and deaths. Contraception is preferable but abortion remains a popular means of birth control, and policy makers should deal with it as appropriate in their countries rather than ignore it.]

Regulation of the size and distribution of population has been practiced by human communities since time immemorial. From his careful review of the medical history of birth control, Himes cites abortion as the chief means of fertility control in primitive societies. The earliest known written abortifacient recipe, from China, is 4,600 years old. Abortion was known in ancient Egypt, Greece, and Rome. Several Greek philosophers, including Aristotle, sanctioned abortion to limit family size. Hippocrates, on the other hand, created reluctance among physicians to induce abortion and imbued certain instances of its practice with a sense of criminality. This reluctance remains with us in Western countries today, and the question of "criminality" is still disputed.

In other parts of the world the death rate has precipitously declined while fertility has generally remained at a high level. The inevitable result has been an unprecedentedly high rate of population growth, called the transitional growth stage of demographic change, in contrast to the posttransitional stage that

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has been reached by Western countries. The problem facing the developing countries is to accomplish the transition from high to low fertility quickly enough to enhance their economic and social development. Whether they can make this transition without the help of induced abortion is a worldwide concern. It is the author's opinion that when developing societies are highly motivated to accelerate their transition from high to low fertility, induced abortion can become such a popular method of fertility control that it becomes a kind of epidemic.

The Prevalence of Induced Abortion in Transitional Societies

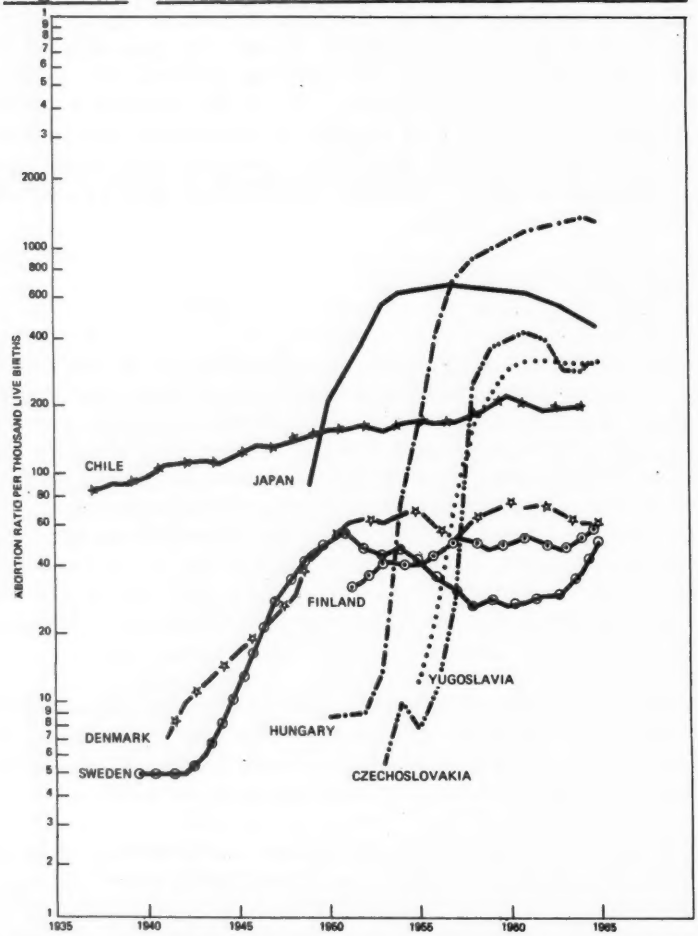
Though documentation is not readily available, it is believed that abortion played a significant role in lowering fertility during the demographic transition in many Western societies in the 18th and 19th centuries. We have almost no data on the incidence of abortion in developing countries before the transitional period—before death rates began to decline—and the current statistics are often inadequate. However, recent studies tend to show a high prevalence of induced abortion in countries where fertility remains high or is just beginning to decline. In the opinion of investigators and many government officials, the current prevalence is higher than it was in the pre-transitional period.

Figure 1 shows the number of abortions per 1,000 live births between 1937 and 1965 for several areas; in the case of Chile, abortion has not been legalized (normally, reliable nationwide information on the subject is not available where the operation is illegal).

Japan's transition. Although Japan is now considered a developed nation, her recent demographic history illustrates what can occur in a developing country which is propelled through a sequence of accelerated social, economic, and demographic transitions. From 1920 to 1948, the Japanese birth rate remained at a fairly high level, around 35 per 1,000 population. During the same period the death rate declined from 25.4 in 1920 to 14.6 per 1,000 in 1947. A significant change took place immediately after World War II: live births dropped from 35 per 1,000 in 1947 to 17 in 1957—a decline of 50 percent in only 10 years. Such a dramatic decline in fertility is extraordinary in the demographic history of the world. Although contraception has been used in Japan for some time, abortion was the main underlying cause of fertility decline during this period. According to Koya, the drop in the birth rate was due 80 percent to abortion and 20 percent to contraception.

Even though comprehensive statistics are not available for the prewar period, it does seem evident that abortion was never absent from the natality scene in Japan. Following World War II, however, abor-

Figure 1: Abortion Ratio per 1,000 Live Births



tions reached very high proportions. As a ratio per 100 live births, legal abortions rose rapidly from 9 in 1949 to over 50 by 1953, and remained in excess of 60 from 1954 to 1962 with a peak of 72 in 1957; in 1965 they were still at the level of 46 per 100 live births. These officially reported figures, however, are estimated to represent only one third to one half of the actual number of abortions performed.

Numerous reasons are advanced for the high prevalence of abortions in postwar Japan. Koya lists the following: a) the amendment of the 1948 Eugenic Protection Law which legalized abortion for medical and social reasons; b) the moral decay of society after the war; c) the attitude of physicians toward their patients; d) the response of the people to the government's efforts to promote family planning and to limit family size. Muramatsu adds that the truly significant fact lies

in the strength of motivation among the general public to adjust the number of children to environment. In Japan abortion is permitted if a pregnancy or delivery threatens the health of the mother because of her physical or financial condition. The assertion that another child will be hard to feed is enough reason for terminating pregnancy. Abortion can be obtained at the cost of about 5 dollars at facilities in both hospitals and specialized abortion centers.

It is highly unlikely that other countries will experience a dramatic lowering of fertility within such a short period. Japan was more modernized before the war than are most developing nations, and her industrial development has been far ahead of other countries in Asia, Africa, and Latin America. Since the war, a wide use of abortion has been legal in Japan, whereas the developing countries, with the exception of Tunisia and possibly mainland China, have yet to accept induced abortion as a legitimate method of fertility control. Nevertheless, the Japanese example may inspire similar policies in some countries that wish to slow down their population growth.

Chile. Chile has less adequate abortion data than Japan; however, hospital admission statistics beginning in 1937 indicate that induced abortion increased tremendously in the period from 1937 to 1964. According to Chilean hospital data for the 24 years ending in 1960, the number of deliveries increased by 1.8 times, whereas the corresponding figure for postabortion hospital admissions was 4.4 and such cases number 20 for every 100 of the country's live births in 1960-64. The actual occurrence of induced abortion is, of course, much higher, as interview studies as early as 1938 reveal. More recent studies, based on better sampling procedures, also point to a higher incidence.

In view of the increasing incidence of induced abortion, it may be surprising that the Chilean birth rate has changed only slightly—from 34.6 in 1936 to 32.8 in 1964. Several factors can be mentioned to explain these figures. First, the official birth rate for 1936 may have been subject to underreporting; the actual level was probably higher. Second, the death rate declined sharply from 25.3 in 1936 to 11.2 in 1964; it is likely that improved survivorship together with generally improved health tended to increase fertility by extending the exposure period and by enhancing fecundity. Furthermore, age-distribution changes which have expanded the reproductive-aged segment of the population pyramid are not reflected in the crude birth rate measure. For these and related reasons, Requena and Monreal's argument that had it not been for abortion the birth rate in Chile for the last 25 years would have been over 40 per 1,000 for the whole country and over 50 for the lower socio-economic groups seems sound.

Korea. According to a recent government study, the percentage of Korean women experiencing induced abortion rose from 7 to 14 percent between 1964 and 1967. The prevalence of abortion was much higher in the urban areas, rising from 15 to 28 percent over the 4-year period. A similar, nearly doubled increase in abortion experience occurred in rural areas where the percentage of women experiencing abortion rose from 4 to 7 percent. During the same period an increase in contraceptive use was noticed, in which the percentage of users rose from 9 to 20 percent of married women. Individual sample surveys confirm these high rates of abortion and provide more details. In a study in Seoul, for example, Koh and Song report the ratio of abortions to live births to be 1 to 3. While the available studies generally indicate a much higher incidence of induced abortion in Korea's urban areas, no significant difference between urban and rural areas was found in a 1966 KAP (knowledge, attitude, practice) survey investigating opinions about legalizing abortion. Of those who expressed an opinion, about 72 percent favored legalized abortion with little difference between urban and rural areas.

Other developing countries. There is scattered evidence suggesting that the beginnings of a great wave of induced abortion may be already under way in many countries that are experiencing rapid population growth. In India, for example, an analysis of pregnancy histories of 5,912 women visiting family planning clinics in New Delhi revealed an average ratio of 9 abortions per 100 pregnancies. In Turkey, a study showed that 39.4 percent of the 496 women coming for contraceptive advice in Ankara Maternity Hospital had had induced abortions at some time in their past. In the United Arab Republic, a sample survey of a rural area in Alexandria governorate found an abortion ratio of 77 per 1,000 live births. Of 3,998 interviewed, 7.1 percent admitted having had an abortion at some time in their lives. In Latin American countries other than Chile, high abortion incidence also exists; studies in Mexico City, Bogota, San Jose, Caracas, Panama, Rio de Janeiro, and Buenos Aires show estimated induced abortions as a percentage of live births ranging from 13 to 33 percent.

Economic Motives for Abortion

The widespread occurrence of induced abortion in a developing society is symptomatic of the intense motivation to limit family size. The social and economic changes in developing countries have brought about a general reversal in attitudes toward children as economic assets. In the past the assurance of a surviving son, the economic gain from child labor, and the guarantee that family members would be cared for in their old age have held high priority and have encouraged high fertility in transitional societies. Demographic and social changes, such as declining infant mortality, child welfare, compulsory education, and social security schemes, have gradually replaced traditional values

with small family norms and low fertility. Concomitantly, the rising costs of housing as a frequent effect of urbanization, longer periods of child dependency as the result of expanded education, as well as the increasing cost of child care for working mothers, are additional factors which may cause the birth of another child to be an economic liability. Resorting to abortion continues to be a sure method of terminating an unwanted pregnancy, even though contraception may be used.

Economic motivation to limit family size has been invoked as the reason for abortion in many countries, regardless of the type of abortion law. Nozue reported that 63 percent of all abortions in Japan are performed for socio-economic reasons. A more intensive study by Koya indicated that 83 percent of the abortions among 1,382 Japanese women were due to fears of difficulty in household financing; the remaining 17 percent were attributed to health reasons. Studies from eastern Europe and the U.S.S.R. show that women cite low income, inadequate housing, excessive numbers of children, and interference with the mother's work as reasons for induced abortion. Studies from France and Sweden revealed that economic indications were responsible for well over half of all abortions. The situation is much the same for Latin America. Rice-Wray reported that among 797 abortions performed among 1,000 interviewed women in Mexico, 46.2 percent were sought as a result of economic pressures compared with 19.9 percent for health reasons. In Chile, studies in three cities indicated that 48 percent of the recorded abortions were due to economic reasons, 10.7 percent for health reasons, and 10.6 percent because of "large family size."

Consequences of Prohibiting Abortion

If resort to induced abortion on a large scale is legally prohibited and there are no highly effective contraceptive programs to compensate, the transition from high to low fertility will be retarded. It is likely that, where pressures to lower fertility are building up, individuals will not await official sanctions but will resort to illegal abortion without adequate medical supervision. Current statistics indicate that abortion is becoming increasingly safer from a medical standpoint, but there are important differences in the case fatality rates from country to country. In general, countries with adequate medical services and liberalized abortion laws have lower abortion mortality rates. The main problem lies in the less developed countries where women, deprived of both medical service and legal sanction, are forced to resort to induced abortion by primitive methods under unsanitary conditions. The women themselves, unskilled neighbors, lay midwives, or medicine men perform the operation.

Table 1 summarizes briefly the legal status of abortion in the world.

TABLE 1

Abortion Laws in Transitional and Posttransitional Countries, 1970

Abortion Laws	Stage of Demographic Development	
	Transitional	Posttransitional
Restrictive laws	Asian countries except Japan African countries Latin American countries	Northern American countries[a] Western European countries Southern European countries Oceanic countries
Liberalized laws	Tunisia (since 1966) Mainland China (1960's) Potentially India (1970?) Potentially Chile (1970?)	Northern European countries (since 1930's) Eastern European countries including U.S.S.R. (since 1955) Japan (since 1948)

[a]By mid-1970 a number of states in the United States had liberalized their abortion laws in varying degrees.

The longest available record of maternal mortality due to abortions is from Sweden. The deaths from legal abortion show a definite decrease in the case fatality rate from 0.20 percent in 1939-48 to 0.04 percent in 1961-64. A government-appointed committee reported that illegal abortion in 1949-51 resulted in a case fatality rate of 1.7 percent, based on 352 cases of which 6 died. Similar abortion mortality statistics have been reported for Finland and Denmark. Despite the significant decline in case fatality rates in these three countries, their current ratios are still higher than those in eastern Europe. This is probably due to the fact that a large number of the legal abortions in northern Europe are performed after the third month of gestation as a result of the long procedure of application to a committee which takes its time in reviewing the application and in giving permission for an abortion.

Case fatality rates from legal abortion in eastern Europe are much lower than in northern Europe: first, because the law is more liberal and therefore more apparently healthy, low-risk women are included in the denominator; and second, because most operations are performed in the first three months of pregnancy. In Hungary, Klinger states that the number of deaths from permitted abortions is currently 2 or 3 per year; the number of deaths resulting from spontaneous abortion or abortion performed without permission is 20 to 25 annually. Before induced abortion was legalized, 80 to 100 women were dying yearly from complications of illegal abortion. Hirschler indicated that for the period 1960-63, the case fatality rate was 0.0031 percent. In Czechoslovakia during the period 1961-64, the rate was 0.0012 percent. Similar very low rates are reported for Yugoslavia

and Romania. The abortion case fatality rate in Japan in 1950-63 is also low, falling from 0.009 percent to 0.004 percent.

The safety of legal abortion in Western nations with restrictive laws varies according to the degree of liberality in interpreting the laws, the place where abortion is performed, the stage of gestation, and the health of the woman. The case fatality rate for criminal abortion in the United States, for example, is unknown but is estimated to range from 0.5 to 1 percent, based on 5,000 to 10,000 deaths precipitated by an alleged annual 1 million or more illegally performed operations. Whatever the actual figure may be, it is a fact that criminal abortion is responsible for a major proportion of maternal deaths in the United States; its share is increased as other causes of maternal mortality are becoming more controllable. For example, Guttmacher found in the 1961 records of New York City that 47 percent of maternal deaths in metropolitan New York were the result of illegal abortions.

In the less developed countries the number of maternal deaths due to abortion is unduly high. Most of the data on this subject come from Latin America. The Chilean data in particular indicate that abortion accounts for almost two fifths of maternal deaths in that country. Armijo and Monreal estimate that the case fatality rate of abortions performed in Chilean hospitals oscillated around 0.5 percent. A Brazilian study reported that puerperal infection has been a major cause of maternal mortality since 1931 and that abortion is responsible for a major proportion of puerperal infection. A Colombia study reports a septic abortion case fatality rate of 4.4 percent in the Child Care Institute of Bogota (1965/66), almost 23 times the maternal mortality rate from all causes in the same institution (0.192 percent). Reports from other developing countries reveal similar findings. Eraj reported that Kenya statistics for 1964 show that abortion deaths were half again the number of deaths caused by malaria. A Malaysia report on a study of 1,000 cases of abortion found a case fatality rate for septic abortion of 3 percent which is more than four times that for all types of abortion (0.7 percent); apparently many of these cases were induced in a non-medical setting.

Effective Contraception and Abortion

Unquestionably, successful prevention of pregnancy through contraception is much wiser and safer than terminating a pregnancy through abortion. Ironically, however, when contraceptive programs are instituted there may be a temporary increase in induced abortions; initial contraceptive failures are frequent, and those who fail often resort to induced abortion. Studies from Japan and Chile illustrate that there appears to be a delayed reaction between

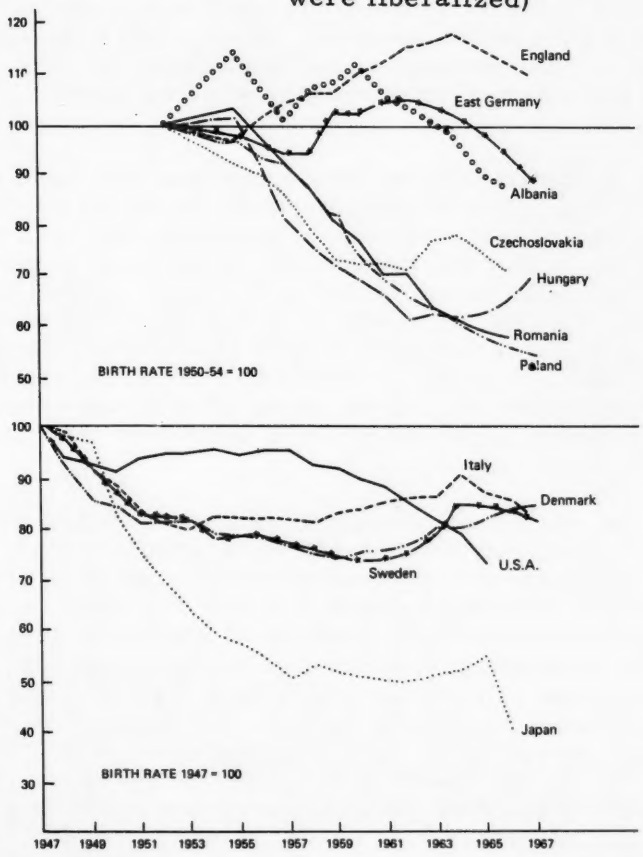
contraceptive program effectiveness and abortion decline. Several reasons for the continued use of induced abortion during an intensive contraceptive program deserve mention.

During the stages when abortion is widely used, either legally as in Japan or illegally as in Chile, many women become "abortion minded." Even when effective contraceptives become available, this group of vulnerable women may continue to rely on induced abortion as a "tried and true" method of family planning. Another reason may be that the continued use of induced abortion is something of a cohort phenomenon. In the early stage of transition, the socially mobile, upper stratum of society adopts small family-size norms more readily and frequently resorts to induced abortion to limit births. With a rise in educational levels and a stabilization of family-size norms, this group turns increasingly to contraception. Yet the abortion wave is maintained, often at an epidemic level, because successive lower strata cohorts are reaching a stage of abortion-proneness. The upper-middle, lower-middle, and lower strata replace each other progressively as cohorts vulnerable to induced abortion, and this process can continue for long periods of time. Finally, when abortion becomes widely accessible—as in eastern Europe with the sanction of the law or in Latin America without it—there is generally an inclination to relax contraceptive efforts.

Effect of Liberalization of Abortion Laws on the Birth Rate

There are various measurements by which the effect of liberalized laws can be determined. It must be acknowledged, however, that none of these methods can unequivocally attribute the observed effect to induced abortion alone. Natality trends in various countries are compared in Figure 2. The upper part of the figure gives a comparison between east European countries, four of which liberalized abortion laws after 1955, and the United Kingdom. Of special interest are the two eastern European countries, Albania and East Germany, which (like England) did not liberalize their laws and did not experience any appreciable decline in natality. The lower part of the figure compares three countries which liberalized their laws in the late 1940s with two countries which did not, the U.S. and Italy. From these comparisons, it becomes evident that the most permissive countries have enjoyed a marked decline in their birth rate in comparison with restrictive countries. The amount of natality decline seems to be related to the extent of liberalization which was more conservative in northern than in eastern Europe. Japan has the most impressive decline; next are the four east European countries.

Figure 2: Changes in Birth Rates in Two Sets of Countries (base years—period when abortion policies were liberalized)



Implications for Policy

This study has emphasized two major themes for policy formation. First, there is no question that prevention of pregnancy through effective contraception is much wiser and safer than termination of pregnancy through abortion. Second, for reasons that vary from one country to another with the dynamics of fertility transition, a margin of induced abortion is to be anticipated and provided for. Policy-makers must recognize that induced abortion is a popular and universal practice which poses profound problems for societies and individuals alike. Beyond doubt abortion is a worldwide problem, though its determinants and solutions differ from one group of countries to another.

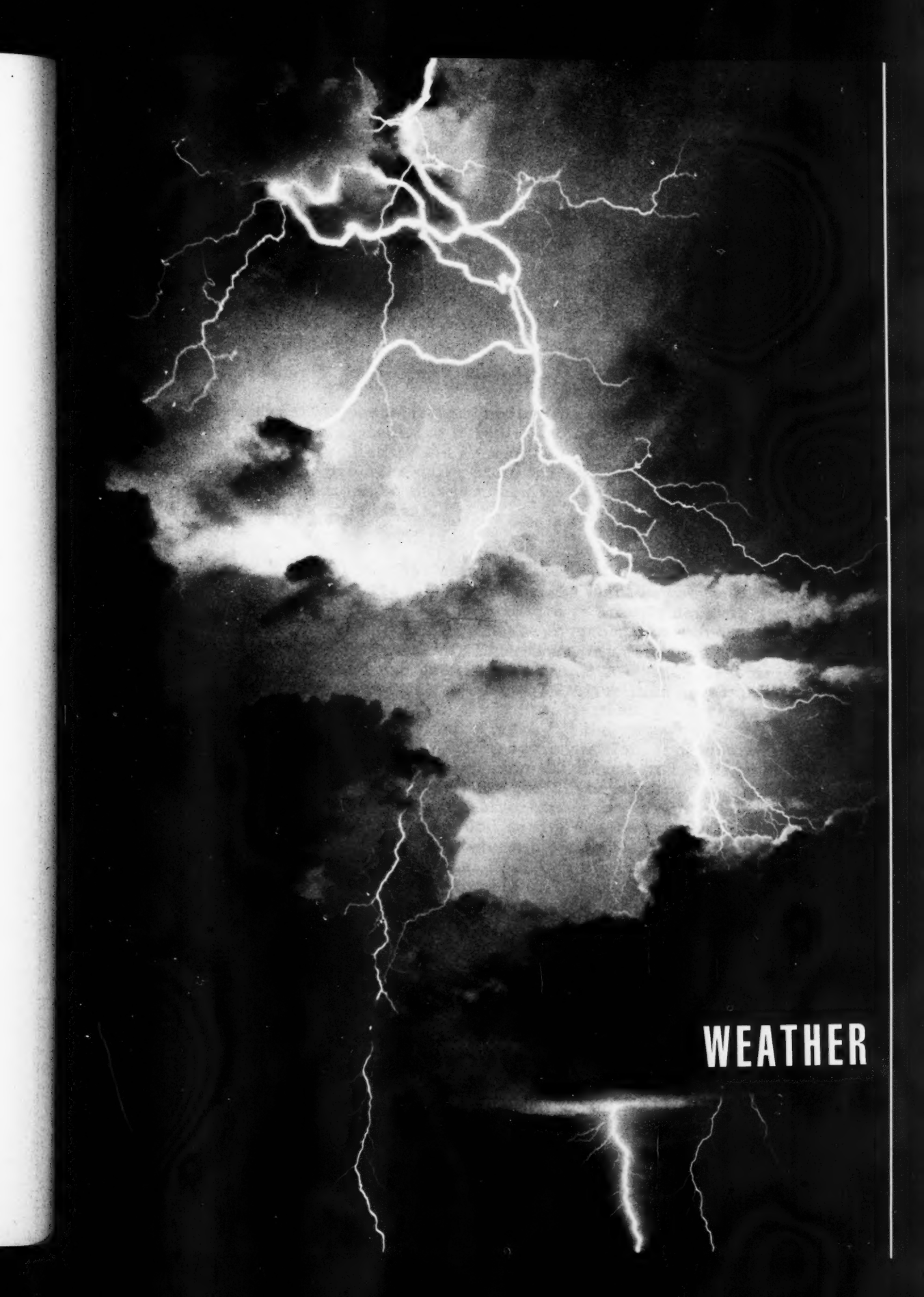
The transitional societies face by far the worst dilemma of all; they have a problem every way they turn. On the one hand, if they

do not have a sufficient number of abortions, their transition to low fertility will be critically retarded. On the other hand, unless policymakers sanction abortion law reform, criminal abortions—provoked by amateurs under dangerous conditions—will mount and foster an extremely serious public health problem. In any case a deluge of cases may overburden already inadequate and insufficient medical services that are needed for many other purposes, whether abortion is legalized or not.

The problem in posttransitional countries that still have restrictive laws is twofold. There is a serious problem of illegal or criminal abortion with all the consequent social, psychological, and racketeering abuses. There is also the problem of inconsistent implementation of ambiguous laws, often favoring the wealthy and not the poor who most need relief. Finally, in posttransitional countries with liberalized laws, abortion prevalence persists despite the fact that contraceptives are widely available. In all three categories of countries, therefore, policymakers should give immediate recognition to the problem of induced abortion and should plan to phase it out rather than pretend it does not exist.

Whereas the primary goal of every fertility regulation program is the prevention of pregnancy through effective contraception, policymakers should recognize that contraceptive failures do occur. In such cases, I would argue that legal abortion is the only rational alternative to the birth of an unwanted child; medical abortion services are needed to ensure that the procedure is performed safely, inexpensively, and without discrimination. Countries which have already liberalized their abortion laws and those which will do so in the future, however, should be warned against overreliance on abortion to solve fertility problems. Abortion should be but one option in the pursuit of fertility control. In all cases, intensive education-guidance programs must be established. Both field and clinical research is needed to provide policymakers with accurate, up-to-date information about the dynamics of abortion.

[Excerpted from Chapter XIII, "Abortion in the Demographic Transition," Rapid Population Growth: Consequences and Policy Implications, Volume II. Baltimore (Md.): The Johns Hopkins Press, for the National Academy of Sciences, 1971, pp. 479-494, 496-497, 500-506, 508, 511-512, and 522-525.]



WEATHER

LIGHTNING
[PHOTO: NATIONAL OCEANIC
AND
ATMOSPHERIC ADMINISTRATION]

Weather Service for Agriculture

R. Ananthakrishnan

[Variations in weather, especially abnormalities in the monsoon rains, cause heavy losses to agriculture in India—some of which could be mitigated by timely prediction and appropriate farmer actions. India's weather service now provides daily radio forecasts; what is needed are timely interpretations so that farmers would know what to do under given weather predictions.]

Of all weather elements, rainfall is the most important single factor that affects plant growth and crop production. Indian agriculture is heavily dependent on the timely occurrence of the monsoon rains and their proper distribution. Four types of variations from the normal can occur in the monsoon rains: a) their commencement may be much earlier than usual or it may be delayed; b) there may be prolonged breaks in the rains in July and August; c) the rains may terminate considerably earlier or persist longer than usual; d) the rainfall may be unevenly distributed, being considerably in excess over certain areas and deficient over others, or excessive during the earlier or later part of the monsoon and scanty at other times. All these abnormalities adversely affect agriculture in varying degrees depending upon the intensity and duration of the abnormality. For instance, if sowing is done in anticipation of normal monsoon conditions, undue delay in the onset of the rains may result in the wilting and drying up of tender plants. In general, the dependability of rainfall is more and its variability less over areas where the total rainfall is large; in the dry areas of the northwest, the farmer is especially vulnerable to monsoon variations.

Cyclonic storms forming over the Bay of Bengal and the Arabian Sea in April and May or in October

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can cause great damage and destruction over the coastal areas when they strike. Little protection to agriculture is possible from strong winds, heavy rain, and at times from tidal waves which inundate low-lying areas with sea water, even with advance weather warnings, although loss of human and animal lives can be minimized. During June through September, a series of depressions which form at the head of the Bay of Bengal and move across the central parts of the country in a west-north-westerly direction play an important role in the distribution of monsoon rainfall over the country. The heavy rainfall associated with them can at times cause disastrous floods, destroying buildings and crops and often many lives. Thunderstorms, hailstorms and duststorms are largely a feature of the hot weather period from March to May. Standing crops and fruit orchards can suffer great damage from a severe hailstorm against which it is hardly possible to take protective measures. It is difficult to predict accurately when or where a hailstorm will occur and the extent of its severity.

Excessive sunshine leads to depletion of soil moisture and accelerates the rate of loss of moisture from the plant. A thin layer of white chalk powder spread over the surface can reduce the soil temperature by as much as 20°C and form a protective device to conserve soil moisture. During prolonged cloudy weather, on the other hand, photosynthesis is reduced and plants become more susceptible to the incidence of pests and diseases.

Sustained strong winds are generally associated with steep pressure gradients which occur in the fields of cyclonic storms and depressions. Very strong winds of shorter duration known as "squalls" occur in association with thunderstorms. Crops exposed to strong winds and squalls suffer damage by lodging. In areas where the prevailing surface winds are strong during certain seasons, the crops can be protected by planting shelter trees called "windbreaks" at right angles to the direction of the wind. Much work has been done in this field in the U.S., resulting in increased crop yields; in our country this matter has not been given the attention it deserves.

Cold waves occur in the winter months over north and central India. Frost can completely damage a grapevine orchard in a single night, for example. The protective measures that can save the crop are the use of windbreaks and the lighting of fires of dried leaves and twigs over different parts of the field to keep air temperature above the freezing point. In the summer months, plants as well as cattle and even human beings can perish under prolonged heat wave conditions; Rajasthan, Punjab, Uttar Pradesh and Bihar are the areas susceptible to summer heat waves.

Weather and the Farmer

The need to provide a special weather service for agriculture was realized by the India Meteorological Department soon after work on

agricultural meteorology was started in 1932. The Agricultural Meteorology Division has a well-equipped field observatory in the local Agricultural College at Poona where studies relating to evapo-transpiration, soil moisture and solar radiation are carried out. Meteorological conditions inside crops are different from those in the free atmosphere; hence for crop-weather studies, routine observations from weather reporting stations, which represent free-air conditions, have to be supplemented by observations recorded at crop-weather stations. For this purpose about 60 crop-weather observatories are maintained at a large number of agricultural farms in different states. In addition, about 100 agro-meteorological observatories function in different agricultural farms located all over the country.

In 1945 a weather service for the farmers was inaugurated. Under this scheme special weather bulletins for farmers are prepared by the Regional Forecasting Offices of the Department at Madras, Bombay, Nagpur, Calcutta and Delhi and supplied to All-India Radio (AIR) stations for broadcasting in several regional languages in their daily rural programs. These bulletins include districtwide forecasts of precipitation, and also information about weather phenomena of importance to agriculture such as dates of onset of rain at sowing time with probable intensity and duration, breaks in monsoon rainfall, heavy rainfall warnings, warnings about strong winds, cold waves, frost, etc. The forecasts cover a period of two days with an outlook for the next two days. There are at present about 60 AIR stations located all over the country which broadcast weather bulletins for farmers in regional languages. These bulletins are also published in newspapers.

Besides the daily weather bulletins for farmers broadcast in the evening as part of the AIR's "rural program," midday weather bulletins are also broadcast daily giving special weather warnings for various user interests such as railway authorities, irrigation engineers, fisheries officials, community development officers, etc. This service has been in operation since 1964.

The radio is the quickest means for dissemination of weather information, but the practical utility of this weather service depends upon the information reaching the farmers. In recent years the number of wireless receivers in the rural areas has been steadily increasing with the availability of low-priced medium-wave sets. In addition, state governments have installed community listening sets in the villages as part of a general program of rural education and entertainment.

The weather broadcasts for farmers are based on "crop-weather calendars" compiled by the Agricultural Meteorology Division of the Meteorological Department in consultation with the various state Agricultural Departments. Information on the major crops grown in the different districts, the dates of sowing, the dates of commencement

and duration of the important cultural operations, and the important periods in the life history of individual crops and their probable weather requirements are depicted pictorially in the crop-weather calendars for guidance of the forecasting officers. The weather requirements of the crops in the different areas at the appropriate time of the year are kept in view while preparing the weather bulletins for farmers. From time to time the crop-weather calendars are updated by maintaining liaison with the state agricultural authorities.

Shortcomings. The radio weather service for farmers suffers from a lack of interpretation of the meteorological information in the bulletins in terms of its implications for agricultural operations. For this purpose it is necessary for the meteorologist and the agricultural scientist to work together. Such a scheme was initiated in Madras some time ago. An officer of the state Department of Agriculture visits the Forecasting Office daily, and after consultation with the meteorological officer he incorporates at the end of the weather bulletin an advisory indicating the actions which farmers should take. This scheme was received favorably by the farmers, and action was initiated by the Meteorological Department to introduce such a practice at all other forecasting offices. However, the response from the state Agricultural Departments has not been encouraging.

We have still a long way to go before scientific weather service will be accepted and acted upon by the cultivators in rural areas. Farmers are, in general, conservative and will not readily accept any changes until they are fully convinced of their benefits. Much work remains to be done by way of publicity and education. It is equally necessary, however, that the weather forecaster have a fuller appreciation of the problems facing the cultivator. The agricultural scientist has to be the liaison officer between the meteorologist in the forecasting office and the cultivator in the field.

Finally, the best organization for supplying timely information along with specific interpretation and advice to farmers is still limited by the kind of information it can supply. This depends on progress in the evolving science of meteorology and in the art of weather forecasting, and also in the comparatively new discipline of agricultural meteorology. Further scientific studies are needed to elucidate the dependence of plant growth and yields on meteorological factors, and to find out the optimum meteorological conditions for the multiplication and spread of pests and diseases. Nevertheless, enough is known to make substantial contributions to agriculture if this knowledge can be turned into timely and pertinent instructions to farmers.

[Excerpted from "Weather Service for Agriculture," Economic and Political Weekly. Bombay: A Sameeksha Trust Publication, Vol. IV, No. 13, 29 March 1969, pp. A31-33.]

[The following extract is from a U.S. Government report cited by Ananthakrishnan as illustrating what he had in mind for India.]

Agricultural Weather Service Program

A pilot project to determine the best procedure for serving an important agricultural area with specialized forecasts and advisories was started in the Mississippi Delta in 1958. Evaluation of this program in 1959 indicated that providing the tailored service saved agriculturists millions of dollars, and the program was expanded to eight other regions in 1962. The Agricultural Weather Service is operating today in 12 service areas where there are valuable concentrations of weather-sensitive crops; these cover about 20 percent of the total area of the U.S. The service provided in these areas represents advanced and effective integration of available meteorological talent with that of specialists of Colleges of Agriculture, Agricultural Experiment Stations, Extension Services, and other components of the Federal and State Departments of Agriculture, to provide users with both short- and long-range planning information and certain specialized services.

The forecasting and interpretation functions are performed at two types of facility. Forecasts are prepared at a National Weather Service Office staffed with forecasters having an agricultural background, using materials from the overall meteorological communications network. One such Office is located in each of the 12 service areas. Interpretation of forecasts and other weather issuances is the responsibility of the Weather Service Office for Agriculture, one or more of which are located at Experiment Stations in each service area.

Weather Service Offices issue general agricultural forecasts covering a 2-day period, with an outlook for the third, fourth, and fifth days. These forecasts are issued three times daily—in the early morning, around noon, and in the evening—to provide guidance in managing farm operations on a day-to-day basis. The forecasts include such elements as expected cloudiness, percentage of area which will have rain and how much will fall, wind speed and direction, dew duration and intensity, and range of high and low temperatures. In addition, forecast advisories may also include predictions of percentage of sunshine, drying rates, evaporation amounts, soil temperature, high-low humidity, ground level temperature, and harvest/haying conditions. Thus, conditions of known significance to agricultural operations are generally forecast without explicitly stating their proximate effects. There are exceptions, however, in certain areas where the Weather Service Offices provide specific operational forecasts for which the forecast techniques are well established; these include, for example, spraying and dusting forecasts and daily drying forecasts for hay.

Weather Service Offices for Agriculture carry the interpretive function a step further. For example, on a daily basis (5 days per week), a farm weather summary is issued as a supplement to the general agricultural forecast of the Weather Service Office. This summary provides an evaluation of the effects of expected weather factors on agricultural operations in progress or planned for the period. Twice monthly, a similar interpretation is issued for the 30-day outlook. In addition, joint specialized agricultural advisories, designed with the immediate problems of the local area in mind, are prepared to aid such critical operations as planting, pest control, irrigation, and harvesting. In each case, the advisory is tailored to evaluate the effects of past, present, and expected weather factors on agricultural operations, permitting the agricultural user to minimize loss or damage from adverse factors or to take advantage of favorable conditions. As an example of the agricultural users' requirements for weather prediction and interpretation, the needs of cotton growers are shown in Chart I.

In addition, a specialized Fruit-Frost Weather Service is provided for fruit growers in six states having concentrated areas of high-value crops that are sensitive to frost conditions. Forecasts are issues several times daily during critical seasons for the crops concerned; these include minimum temperatures expected at key points, wind, cloud cover, and temperature inversions.

[Excerpted from Federal Plan for a National Agricultural Weather Service, Report by the National Oceanic and Atmospheric Administration, Department of Commerce. Washington (D.C.): U.S. Government Printing Office, January 1971, pp. 20-24, Chart p. 9.]

Chart I: Agricultural Weather User Requirements For Cotton Producers

Important Parameters	Operational Requirement: Description	Operational Requirement: Forecast Period
Planting:		
1. Soil moisture	Less than 80% field capacity* to 4-in. depth	Up to 2 weeks
2. Soil temperature	Greater than 65°F	Up to 2 weeks
3. Temperature (air)	Greater than 50°F	Up to 36 hrs.
4. Precipitation	Less than .05 in.	Up to 12 hrs.
5. Wind	Less than 25 m. p. h.	Up to 12 hrs.
Defoliation:		
1. Soil moisture	Between 50% and 80% field capacity*	Up to 48 hrs.
2. Temperature (air)	Between 50° and 85°F	Up to 36 hrs.
3. Precipitation	None	Up to 24 hrs.
4. Wind	Less than 10 m. p. h.	Up to 18 hrs.
5. Dew	Presence and period	Up to 12 hrs.
6. Cloudiness	Less than .7 cover	Up to 12 hrs.
Harvesting:		
1. Soil moisture	Less than 90% field capacity* to 6-in. depth	Up to 48 hrs.
2. Temperature (air)	Variable	Up to 36 hrs.
3. Precipitation	None	Up to 12 hrs.
4. Wind	Less than 20 m. p. h.	Up to 36 hrs.
5. Humidity	Less than 70% relative humidity	Up to 12 hrs.
6. Dew	Presence and period	Up to 24 hrs.

*Field capacity—The amount of water held in the soil after the excess gravitational water has drained away and after the rate of downward movement of water has materially decreased.

World Weather Watch

Report of the U.S. Government,
April 1971

[The United Nations World Meteorological Organization (WMO) coordinates an elaborate worldwide network of satellite, land and sea facilities for observing and reporting weather conditions, and global telecommunications and data processing systems to transmit and analyze these observations and make weather forecasts.]

Since the first international meeting in 1853 to establish an exchange of weather data among nations, this kind of activity has gradually been growing in scope and capability. Today a World Weather Watch is coordinated internationally by the World Meteorological Organization, a specialized agency of the United Nations, with 133 members. The Watch is proceeding in 4-year phases, with the first phase completed at the end of 1971. During this first phase, the major effort of the program was to remedy the more critical deficiencies in the existing international weather system. The plan for the next phase of the World Weather Watch in 1972-75 calls for two or three polar-orbiting and four geostationary satellites as an integral part of the Global Observing System, and for international collection and exchange of meteorological data obtained from the satellites. Completion of the global communication circuits is also planned as part of this second phase. In addition, heavy emphasis is placed on the installation of conventional sounding systems in the tropical land areas. A new dimension is now part of the Plan and is concerned with monitoring of atmospheric pollutants on a global basis; a network of regional and baseline stations has been proposed.

Global Observing System

The space-based observational capability is and will continue to be one of the keystones of the World Weather

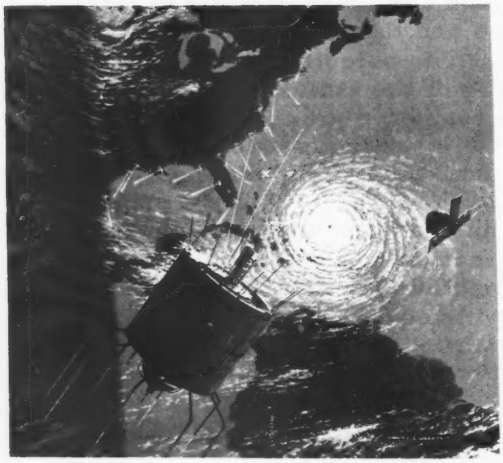
Watch. There are, at present, two operational satellite systems that provide regular information for use by national meteorological services. These are the Improved TIROS (Television Infrared Observation Satellites) of the United States and the satellites of the meteorological system of the U.S.S.R. The objectives are: 1) Continuous viewing and quantitative sounding of the atmosphere to acquire and transmit data for numerical weather prediction. 2) Global imaging of the atmosphere on a daily basis; direct readout services are provided by automatic picture transmission (APT) during the daytime, and by the scanning radiometer (SR) at night. 3) To provide a capability for warning the public of impending weather disasters. The APT has been very valuable to the national meteorological services of the world by providing instant weather information on thousands of miles of area surveyed by the receiving equipment. (The U.S. satellite system is the only one with a direct readout capability that can be received by relatively inexpensive ground receivers throughout the world.)

The most urgent need in the Global Observing System is to increase surface and upper air observations in the tropics, the southern hemisphere, and the ocean areas of the northern hemisphere. The ocean areas are the most critical, but even over land areas, there remain significant gaps in the observational networks in certain portions of Brazil, in the desert regions of North Africa and Southwest Asia, and in part of the Southwest Pacific. Recent experimental work with meteorological satellites has shown that it is possible to measure the sea-surface temperature with an accuracy of about $\pm 1\,^{\circ}C$. There have also been outstanding successes with research satellites in deriving vertical temperature and humidity profiles by the inverse radiation technique and in deducing the wind field by the measurement of cloud displacements. The current network of conventional surface and upper air observations is being supplemented increasingly by data obtained from meteorological satellites, but it will still be necessary in 1972-75 to rely on this conventional synoptic network as a primary source of upper air data.

The basic data for the Global Observation System originate largely in the land-based meteorological observation stations of the WMO member countries. The World Weather Watch criterion is a maximum average spacing of 500 kilometers between observing stations on land; networks to meet national needs may be more stringent. A program is now underway to replace obsolete equipment and to fill the gaps in the surface observational network by new, partly or fully automatic weather-observing stations.

At sea, several thousand ships routinely make surface weather observations and radio reports to shore stations. A limited number of merchant ships have also installed equipment for making upper air observations. In addition, there are 13 specialized Ocean Station

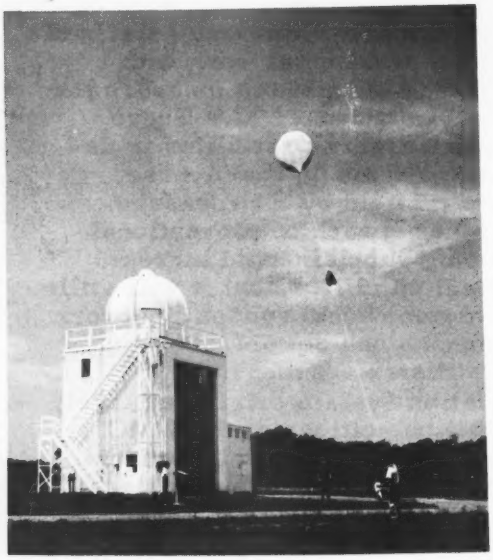
WEATHER TECHNOLOGY
[PHOTOS: NOAA]



Left: Weather satellites: lower left—stationary satellite; right—orbiting Improved TIROS. Radar stations pictured along coast; hurricane clouds at sea.

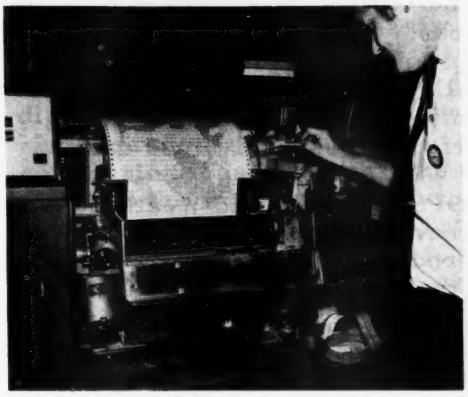
Right: Hurricane observed in a radar scope.

Left: Ground observation station.



Right: Balloon carrying instruments for sea observation.

Right: Satellite picture of northern hemisphere down to equator, showing eight major storms—the largest number spotted by satellites in one day.



Left: Computer print-out of circulation in upper atmosphere.

Right: Indian technicians preparing weather chart.

Left: Meteorologist studying mosaic of satellite pictures of a hurricane.

Vessels in the North Atlantic and the North Pacific Oceans which make regular surface and upper air observations. In accordance with the World Weather Watch Plan, these Stations should be maintained without reduction in number or program until such time as completely satisfactory and proven alternative observing systems are available. South Africa has placed a new Ocean Station Vessel in the South Atlantic Ocean for a minimum period of a year. Starting in 1970, the U.S.S.R. has stationed a weather ship east of the Philippines in the Pacific Ocean from June to August to provide support for typhoon weather observations, and is expected to continue the program on a yearly basis.

Aircraft meteorological reports from civilian and military aircraft provide valuable weather information, particularly over oceans and other data-sparse areas. Certain military reconnaissance flights obtain weather information at flight level and vertically downward to the surface at fixed points along these tracks. On selected flights, aircraft equipped with bathy-thermograph equipment measure ocean temperatures to a depth of 1,000 feet. Specially equipped aircraft are deployed at strategic locations in the Atlantic and Pacific, and special aerial reconnaissance flights are often performed several times daily.

The Global Data Processing System (GDPS) of the World Weather Watch is designed to support the national meteorological services of the world with processed meteorological products on a global or regional scale. The System also ensures the processing of data for climatological and research purposes and the storage of data for ready retrieval. The GDPS operates through a system of World, Regional, and National Meteorological Centers. Three World Meteorological Centers (WMC) are in operation at: Melbourne, Australia; Moscow, U.S.S.R.; and Washington, D.C. One of their most important functions is to provide meteorological analyses and forecasts on a global scale.

On a typical day, the WMC in Washington processes more than 40,000 surface observations, 2,000 ship reports, 1,000 upper air soundings, 2,000 aircraft reports, and global cloud cover data. The World Weather Watch Plan lists 21 Regional Meteorological Centers (RMC); with one exception, the Centers have been set up and are preparing meteorological analyses and forecasts on a regional scale for assigned areas. The continued development of these Centers and their conversion to computer techniques will result in an increase in RMC support provided to the National Meteorological Centers (NMC).

In addition to their weather analysis and prediction services, both RMCs and WMCs provide support to many specialized activities. The main support to aviation is provided through the area forecast system. Information describing the state of sea, sea ice, and sea-surface temperature is now available to support shipping and other marine activities.

The main improvement needed in the GDPS at present is to reduce the time between receipt of the raw observational data at the Regional and World Meteorological Centers and the availability of the output product to the user. To meet this goal, the installation of computers at all Regional Meteorological Centers, in conjunction with training programs, is necessary. Once completed, the introduction of digital techniques in data processing would considerably reduce the time required for generation and availability of forecasts.

The Global Telecommunications System (GTS) is the backbone of the World Weather Watch, providing for the collection, exchange, and distribution of observational and processed data among the WMCs, RMCs, and NMCs. Through 25 Regional Telecommunication Hubs (RTH), the GTS serves the three WMCs, 21 RMCs, and 147 NMCs or Centers with similar functions worldwide. The GTS is organized on a three-level basis: 1) the Main Trunk Circuit connecting the three WMCs; its principal function is to ensure rapid and reliable exchange of the observational data, including satellite information in digital form required for analyses and forecasts on a global scale, and of processed information issued by the WMCs. 2) Regional Telecommunications Networks are designed by each of the six regional areas of the WMO to meet the needs of the national meteorological services of that region. 3) The National Networks; under the World Weather Watch Plan, the NMCs are required to complete the collection of observational data originating in their countries as soon as possible to meet the 2-hour time limit for receipt of these data at the WMCs. A number of countries are receiving support under the WMO Voluntary Assistance Program in implementing their National Networks. Telecommunications equipment is being provided by WMO members through this Program for Regional Telecommunication Hubs in Brazil, United Arab Republic, Kenya, India, Czechoslovakia, Senegal, Thailand, Nigeria, Iran and Venezuela.

The Global Atmospheric Research Program of the World Weather Program is designed to provide mankind with very substantial improvements in weather prediction services. Intensive planning activities, both nationally and internationally, have resulted in several recommended research programs. The program over the next few years will focus on: 1) Mathematical modeling and simulation of the atmosphere. 2) Assessment of the effects of man's pollution on the atmosphere. 3) Implementation of a major international tropical experiment in the Atlantic during 1974. 4) Planning for an international global observational experiment in 1976 or 1977.

Concerning the third item: Most of the energy received from the sun is used to evaporate moisture over the oceans, especially in the tropics. As the evaporated moisture condenses into clouds, latent heat is released into the air; it is this latent heat which drives the

atmospheric circulation. The mechanisms by which the small clouds become concentrated in cloud clusters and by which the energy released by cloud clusters is fed, in turn, into the large-scale tropical circulation and into the circulation patterns at higher latitudes are not well understood. Equally as little understood is the manner by which some of these local atmospheric circulations develop into giant tropical disturbances or hurricanes. The highly important tropical experiment now planned for 1974 in the Atlantic Ocean between Africa and South America is designed to provide an understanding of these mechanisms. Some 16-24 ships, 7 aircraft, and 8 types of space satellites have been promised for participation in the experiment.

[Excerpted from World Weather Program: Plan for Fiscal Year 1972. Washington (D. C.): U. S. Government Printing Office, April 1971, pp. 6-15, 17.]

Progress in Weather Modification

[Techniques for altering weather are being investigated on an increasing scale, and control methods—though still largely experimental—are further advanced than is generally realized. Most of these employ chemicals injected into clouds to produce rain or snow; mathematical models of cloud characteristics and sophisticated measurements are being developed. Some new possibilities relate to modification of hurricane winds, hailstorms, and perhaps lightning.]

One. . . . . Richard D. James is a Staff Reporter for The Wall Street Journal, New York.

Techniques for Altering Weather

One recent afternoon in Florida, a DC-6 flew into the tops of a series of clouds, and 208 silver iodide flares were dropped from the wing tips of the plane. These flares burned up while falling to the ground, and filled the clouds with smoke containing trillions of small crystals intended to make the clouds produce more rain over an area suffering from drought. The National Weather Service had predicted only one chance in five of natural rainfall that day, but in the six hours after the "seeding" of the clouds downpours of up to five inches fell in the affected areas. This mission was the most successful in a series flown by National Oceanic and Atmospheric Administration (NOAA) of the U. S. Department of Commerce, under a program which has been gaining momentum in the last few years. "We still have a lot to learn, but weather control is further advanced than the public generally realizes," says Robert M. White, director of NOAA.

This contrasts with the situation in the 1950s when weather control developed a bad name. In 1946 two General Electric Company researchers found that seeding winter clouds with dry ice pellets seems to produce snow; later, hundreds of "rainmakers" began trying to sell their services to farmers and others.

Scientific knowledge was scanty, seeding techniques were crude, and failures were frequent; the public reacted by labelling such efforts as fakery. In 1960 the U. S. Government undertook a general study of the field, which concluded that more research was warranted. Accordingly, weather control research projects have been supported on an increasing scale—estimated at $20 million in fiscal year 1971/72.

The seeding of cumulus clouds in the Florida area, referred to above, is one of the most successful of these projects. The technique is based on the assumption that bigger clouds should produce more rain than smaller clouds because they contain more moisture and last longer. Dr. Joanne Simpson began by searching for a way to grow big clouds from small ones by heating. Clouds carry much of their moisture in supercooled water—water that remains liquid at temperatures well below 0^{o}; adding silver iodide crystals to a cloud would turn this liquid to ice and generate heat. In 1963-65 experiments over the ocean, shooting rockets with silver iodide into the tops of cumulus clouds and using many times larger quantities of that chemical than cloud seeders had previously used, did expand the clouds—within minutes the seeded clouds rose and towered 20,000 feet or more above their unseeded neighbors. The rain they produced was hard to measure over the ocean; in 1968 experiments over land began, which indicated that rainfall from individual clouds could be increased very substantially in this way [discussed more fully below]. The method should become economically feasible, researchers believe: the successful day's cloud seeding mentioned earlier, at a cost of about $7,500, produced over 10,000 acre-feet of water (enough to cover 10,000 acres with one foot depth of water) which, if delivered in the right places and valued at the prevailing price of $50 per acre-foot for irrigation water, would amount to $500,000.

A similar method for increasing snowfall is being tested in southwest Colorado, beginning in late 1970 and continuing through 1973 [see below]. Another snowfall project is aimed at redistributing the snow which tends to fall in a concentrated band along the eastern shore of Lake Erie. Here the scientists theorize that seeding clouds with dry ice pellets will cause the formation of many more and hence lighter snow crystals, and these will fall more slowly and be blown further inland, spreading the snowfall more thinly over a larger area.

Still another application of cloud seeding is the possibility of modifying the velocity of winds in a hurricane. The method would be to use the heat generated by silver iodide seeding in the right places to reduce the sharp difference in atmospheric pressure between the "eye" of the hurricane and its outer edges, a difference that produces the strong destructive winds. In 1969 a hurricane was seeded on August 18 and winds slowly decreased by 31 percent; no seeding was done the next day, and winds increased; on August 20 seeding

was done, and again velocity decreased. "We're not sure that the seeding caused the decreases, but analyses of past storms show that type of behavior by a hurricane would be very rare," states R. Cecil Gentry of the National Hurricane Research Laboratory.

Not everyone is happy with scientists' growing ability to control the weather, because it raises new legal, social and ecological problems. In Colorado, for example, some residents are upset at the prospect that more snowfall would increase the danger of snow avalanches on mountain roads. In Florida, tomato growers threatened a court injunction against cloud seeding because rainfall during harvest badly damages their crop. In both cases scientists were able to limit the area or shift the time of their operations to avoid these possibilities.

[Excerpted from "Scientists Finally Find Dependable Techniques for Altering Weather," The Wall Street Journal. New York: Dow Jones & Co., Inc., 12 July 1971, pp. 1 and 17. Copyright © 1971 by the Dow Jones & Co., Inc.]

Two. . . . . Dr. Allen L. Hammond is on the staff of Science Magazine, the American Association for the Advancement of Science, Washington, D. C.

Weather Modification: A Technology Coming of Age

Attempts to modify the weather have a long and controversial history. Because meteorological phenomena show large natural variations, it has often proved difficult to determine what effects, if any, are caused by human intervention. Despite past problems, there is now considerable optimism among meteorologists who are working on weather modification techniques. Cloud seeding techniques are the basis of most such attempts; increased understanding of the physics of cloud systems has brought weather modification to a new stage of development. One feature that distinguishes present efforts from most earlier attempts is the use of detailed mathematical models of the phenomena being modified to determine suitable conditions for seeding and to predict the resulting effects. The favorable results of a number of recent experiments indicate that operational programs may become feasible in the not-too-distant future.

Seeding techniques for all types of weather modification depend on the providing of nuclei on which condensation or freezing of the water

vapor and supercooled moisture in the air can take place. Silver iodide is most commonly used for this purpose because it readily forms large numbers of suitable particles; lead iodide, dry ice, and even table salt have been used as well. The effects of seeding on a particular cloud appear to depend dramatically on such details as cloud temperature, number of nuclei present, and where in the cloud nuclei are added, so that seeding at random is not very likely to produce desired results. If the number of naturally occurring nuclei is sufficient to allow the freezing of much of the available supercooled water in a cloud, for example, the addition of more nuclei is thought to result, on the average, in smaller ice crystals; the smaller crystals melt and evaporate more rapidly on their way down so that less precipitation reaches the ground. Very strong storms with taller and cooler clouds are often relatively efficient in releasing their moisture, so that it appears to be the warmer and more marginal cloud systems that offer the best chance for man-assisted increases in precipitation.

A variety of methods are used to get the artificial nuclei into the cloud. For most applications flares containing silver iodide are ignited and dropped from a plane. Airborne ramjet generators that burn acetone with silver iodide have also been developed; these generators are capable of delivering large numbers of nuclei at the controlled rates necessary in some research applications. Ground-based generators, which are lower in cost but which must depend on the prevailing wind to transport the nuclei up into the clouds, are also used. Rockets and artillery shells have been used to deploy seeding material in hail-suppression programs in the Soviet Union.

The largest weather modification experiment, and the closest approach to operational control of precipitation over a whole season, is a project now underway in the mountains of Colorado. On the basis of prior experience on a smaller scale, the scientists estimate that a winter's snowfall in a 1,300 square mile area can be increased by 16 percent with some regularity, using only ground-based generators rather than airplanes. When this additional snow melts, it could add some 250,000 acre-feet of water to the Colorado River drainage basin on which much of the southwestern U. S. depends heavily for irrigation water. Studying the flow of air and clouds over these mountains, and measuring cloud characteristics in a laboratory cloud chamber, the scientists developed a computer model for the growth and behavior of different types of clouds, and for their reactions to seeding with varying amounts of silver iodide. The computer model predicts that when cloud top temperatures are relatively warm, i. e., -4° to 14° Farenheit, seeding will increase snowfall (in initial tests by 100-200 percent), and when temperatures are colder the snowfall will decrease (by perhaps 30 percent). Thus, the method might also be used to reduce snowfall during severe winters when it is feared that a heavy spring runoff might produce floods.

A common concern expressed in connection with weather modification is that successful cloud seeding in one region would cause decreased precipitation in downwind areas. There is apparently no well-documented evidence that any large effect occurs; downwind effects, positive or negative, seem to depend mainly on local situations. On the average only about 10 percent of the moisture of the air falls naturally as rain or snow, and a seeding program such as the Colorado experiment removes only an additional 1 to 2 percent. Because this project may lead rapidly into an operational program, it is being studied unusually carefully. A preliminary survey showed no signs of short-term ecological effects, since the additional snowfall expected is well within the range of the natural variation of the region's precipitation. Scientists from several Colorado universities are undertaking a detailed 4-year study of the long-range impact of the cloud seeding on plants, animals, and climatic change.

A different weather modification technique under development in Florida is aimed at increasing rainfall by expanding cumulus clouds. In cumulus clouds buoyancy forces control the cloud's rate of growth, so that seeding may cause the cloud to grow higher and more rapidly than it otherwise would; in contrast, the rate of growth of orographic clouds (mountain-produced clouds) is usually controlled by larger circulation patterns, so that seeding does not appreciably affect the overall flow field. The results of a series of experiments by the NOAA scientists, headed by Joanne Simpson, indicate that seeded clouds yield on the average more than three times as much rain as unseeded clouds. The seeding technique is most successful on fair days; on rainy days, seeding seems to be ineffective or to have the effect of slightly decreasing rainfall. But there are very large differences among the results on fair days; rainfall increases obtained so far show greater variability and thus more unreliability in supplying irrigation water than those anticipated in the Colorado experiment.

Although the seeding of individual clouds seems to be a proven technique, it yields only 100 to 250 acre-feet of additional water per cloud. In contrast, when two single clouds merge, they can release more than 30 times as much water as a single cloud, according to Simpson. Hence the possibility of promoting mergers and other multicloud systems by seeding adjacent clouds appears to offer the best hope for large-scale rainmaking if a reliable method of doing this is discovered. The extent to which the computer model and seeding techniques developed for the semitropical conditions of southern Florida will be applicable to cumulus clouds in other areas is still unknown; in general, they should be relevant to areas where rainfall usually originates in clouds formed over adjacent tropical oceans.

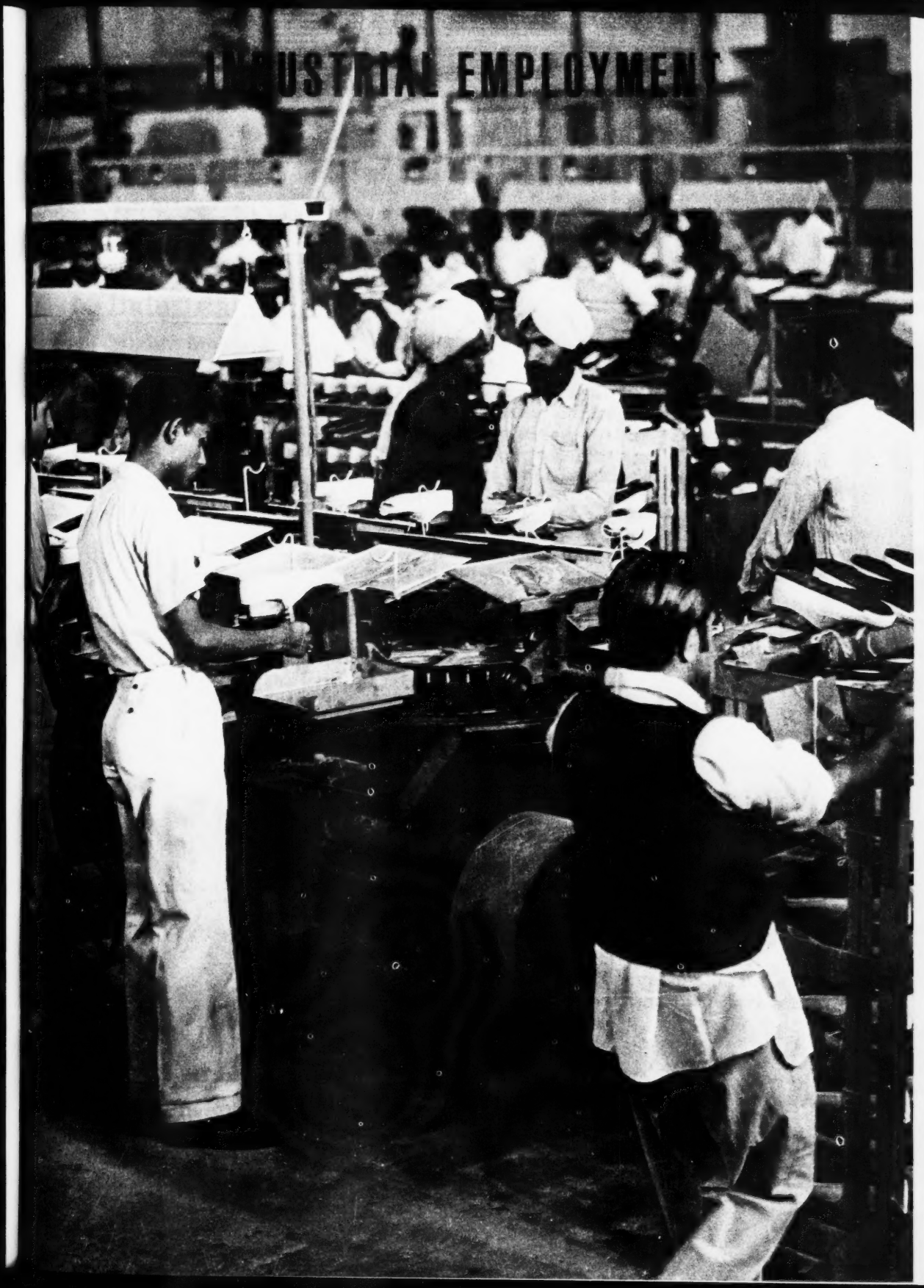
One of the more exotic possibilities of weather modification is the suppression of cloud-to-ground lightning, which every year starts

large numbers of forest fires. Apparently lightning from small, dry storms is most frequently responsible, since larger storms often put out their own fires. Although electrical processes in a cloud are poorly understood at present, one hypothesis holds that electrical charges are built up by the interaction of liquid and solid particles. Hence by overseeding a cloud to convert all of its supercooled water into ice, the microphysical balance is changed in a way that is thought to favor shorter and less frequent lightning discharges. A small group of scientists in Montana are modifying existing cloud models to include electrical effects, and designing field experiments. The research is still in its preliminary stages, but very limited tests several years ago give some basis for encouragement.

A large hail research project funded by the National Science Foundation is scheduled to begin exploratory seeding experiments in Colorado in the summer of 1972. No models of hailstone growth are available at present, but efforts to develop them are under way. Modeling work is also proceeding on hurricanes, and three storms have been seeded in past years to see whether their wind velocities can be reduced. Other efforts are aimed at dispersing fog.

Although seeding techniques are still experimental, in several cases they have been applied in near-emergency situations. At the request of farmers, NOAA scientists in Florida seeded clouds in an attempt to alleviate a severe drought in 1971, and during the forest-fire season the Forest Service has seeded in high-risk areas of the northwest in response to local pleas for help. As seeding techniques continue to improve, it is likely that they will be increasingly called upon. But the operational use of weather modification techniques on a large scale raises difficult questions about legal responsibilities, conflicting desires, and appropriate governmental regulation. At the current rate of progress, the remaining scientific problems involved in this new technology will undoubtedly be resolved before the legal and political mechanisms to oversee its use are established.

[Adapted from "Weather Modification: A Technology Coming of Age," Science. Washington (D. C.): the American Association for the Advancement of Science, Vol. 172, No. 3983, 7 May 1971, pp. 548-549. Copyright © 1971 by the American Association for the Advancement of Science.]


INDUSTRIAL EMPLOYMENT

SHOE FACTORY IN FARIDABAD, INDIA
[PHOTO: MOTTAR]

Employment Aspects of Industrialization in Asia

M. M. Mehta

[Industrial growth trends in Asia show much slower increases in employment than in output, due to increasing capital-intensity resulting partly from a shift toward heavy industries. Labor-intensity does not necessarily mean higher capital-output ratios nor smaller rates of profit. An employment-oriented industrial strategy should emphasize fuller use of capacity, promotion of labor-intensive products and production methods, and an expansion of small-scale industries.]

Analysis of the global trends in industrial data for 1955-66 assembled by the United Nations reveals the following characteristics: 1) Manufacturing output has grown at a much faster rate than manufacturing employment. 2) The pattern of output and employment has shifted from light industries in favor of heavy industries. The dynamic manufacturing sector comprised chemical and petro-chemical industries, metal products, non-metallic mineral products and basic metals; while the stagnant manufacturing sector comprised textiles, clothing and footwear, wood products and furniture, and food and tobacco manufacturing. 3) The heavy manufacturing industries, being more capital-intensive in character, offered much less scope for employment generation than the light manufacturing industries. Consequently, the shift in the pattern of output from light to heavy manufacturing tended to slow down the contribution of industrialization to employment. 4) The faster rate of growth in productivity in heavy compared to light manufacturing tended to widen further the disparities in the growth of output and employment.

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These trends are reflected much more prominently in the figures for Asia. While the manufacturing output index for the world rose by 100 percent and the index for employment by 37 percent, in Asia the corresponding values were a 247 percent gain in output but only 71 percent in employment. As can be seen in Table 1, the employment/output ratios decreased more sharply in heavy industry than in light industry generally; in Asia, the decreases in these ratios were more rapid, and the shift toward heavy industry was also more rapid as shown by the very large rate of increase in its output.

Table 1: Changes in Index Values, 1955 to 1966

(in percentages)

	All Manufacturing	Light Industry	Heavy Industry
World			
Output	100	67	122
Employment	37	30	48
Employment/Output Ratio	-31	-22	-34
Asia			
Output	247	130	411
Employment	71	54	118
Employment/Output Ratio	-51	-33	-58

DATA SOURCE: The Growth of World Industry, United Nations, 1969.

This steep and continuous decline in employment/output ratios in Asian manufacturing (and also in all the nine major groups of manufactures individually) indicates that the capacity of this sector to generate direct new employment opportunities has considerably slowed down. This is a result partly of the modernization process and the increasingly capital-intensive character of new investment, and partly of significant advances in productivity within existing industries. The movement towards application of science and modern technology to production processes appears to have progressed faster in the newly set up, well organized, capital-intensive heavy manufacturing sector—i. e., the area of most rapid growth—than in the comparatively old and less capital-intensive light manufacturing sector. In the new factories of all types, the element of "learning by doing" also appears in the increases in labor productivity (i. e., the inverse of the employment/output ratios).

Capital Intensity of Industries in Asia

The terms labor intensity and capital intensity have been loosely used to indicate any of the following: the capital-labor ratio, the capital-wage ratio, the capital-output ratio, the capital turnover rate, or the ratio between initial cost and annual cost. In this paper focused on employment, we have restricted the concept of capital intensity to the capital-labor ratio—the amount of fixed capital per man employed (labor intensive simply means a low capital-labor ratio). The capital-output ratio will also be used, but it is more an indicator of capital productivity than of capital intensity.

Table 2 gives a comparative picture of the capital intensity of the major groups of manufacturing industries in seven countries of the Economic Commission for Asia and the Far East (ECAFE) region. The statistics on fixed capital derived from the national censuses of manufactures are subject to various reservations arising not only from the differences in concepts, scope and coverage among these censuses but also from the national practices followed in valuation of fixed capital and in provision for depreciation; the figures had to be converted into U. S. dollars at official rates of exchange.

Table 2: Fixed Capital Per Person Employed in Manufacturing Industries in Selected ECAFE Countries

(in U. S. dollars)

Manufacturing Industries	Taiwan 1965	India 1963	Republic of Korea 1966	Pakistan 1960	Philippines 1965	Thailand 1963	Japan 1965
All Manufacturing	2,255	1,453	1,167	917	2,581	1,780	2,579
Food	2,656	925	1,221	1,186	2,887	2,349	2,199
Textiles	1,232	624	938	716	3,622	1,180	1,567
Paper and Allied Products	2,244	2,818	1,664	3,721	5,190	9,742	3,883
Rubber Products	756	1,272	626		2,645	1,035	1,756
Chemicals	5,514	3,523	1,807	1,573	2,948	2,196	6,459
Non-metallic Minerals	3,150	1,220	1,805	1,456	5,190	2,230	3,072
Metal and Metal Products	2,528	4,951	1,448	839	3,395	1,291	1,630
Machinery and Parts	630	1,200	1,070	546	1,577	923	2,087
Electric Machinery and Appliances	1,242	1,483	1,112	924	1,695	1,750	1,732
Transport Equipment	1,331	930	1,222	193	1,739	1,499	2,450

SOURCE: National Censuses of Manufacture

The Table shows significant intercountry and interindustry differences. In almost all the major industry groups, capital intensity appears to be much higher in Japan, the Philippines and Taiwan than in Pakistan, India, Korea or Thailand. Generally speaking, the more capital-intensive industries are chemicals (including petroleum products and fertilizers), non-metallic minerals (cement) paper and metal products. It should be noted that 'food, tobacco and beverages'

appears to be more capital-intensive than textiles, rubber and even machinery and transport equipment. Some groups of manufactures appear to be highly capital-intensive in some countries, e. g., chemicals in Taiwan, metal products in India, paper in Thailand, food and textiles in the Philippines, and chemicals and machinery in Japan. These differences, of course, result from the different products within these broad categories that are manufactured in particular countries as well as from the national differences in industrial techniques. [Analysis of subcategories omitted.]

It has been strongly argued that in the densely populated, capital-deficient, underdeveloped countries of Asia, where massive unemployment and underemployment prevail, the labor-intensive and capital-saving industries would economize the use of scarce capital resources and simultaneously provide more employment opportunities. The advocates of this approach maintain that, in most cases, investments in labor-intensive or capital-saving production could secure the maximization of both income and output. Some economists, however, do not share this optimistic view. They have asserted that labor-intensive production is incompatible with economic growth and that capital-intensive production could promote a more rapid rate of growth and consequently a larger output and employment, because both the rate of saving and the rate of reinvestment are higher in the more capital-intensive industries. In addition, it is argued that the "inefficient" labor-intensive industries use more capital per unit of output than the capital-intensive industries. If total output is to be maximized from the limited capital resources available to the developing countries, these should be utilized in a manner that could maximize the net value added and, therefore, capital-intensive industry should be encouraged.

To answer one of the questions involved, it is necessary to examine the capital requirements per unit of output (capital-output ratio) in the different manufacturing industries. Analysis would reveal whether the capital requirements per unit of output are in fact higher in labor-intensive than in capital-intensive industries; whether there are significant intercountry and interindustry differences in capital-output ratios in Asian manufacturing; and whether, for planning purposes, it is possible to identify certain prospective industries which have both low capital requirements per worker (low capital-labor ratio) and also low capital requirements per unit of output. Table 3 gives figures for capital-output ratios in the same industry groups of the seven Asian countries.

In almost all the major groups of manufacturing, capital-output ratios are much lower in Japan than in other Asian countries. The ratios also appear to be substantially lower in most of the industries in the Philippines and Korea than in similar industries in India, Pakis-

tan or Taiwan. In Japan capital-output ratios are much higher in paper, chemical and non-metallic mineral manufacturing than in rubber products, electric machinery and transport equipment, and the same is true in India and Taiwan. Capital-output ratios are especially high in certain specific cases: in the textile and food industries in the Philippines and Thailand, in the chemical and metal industries in India and Taiwan, and in the paper industry in Thailand and Pakistan. The high capital-output ratios in general represent low productivity of capital. In many cases, the existence of large unutilized capacity is an important contributing cause.

Table 3: Capital-Output Ratios in Major Groups of Manufacturing Industries in Some Selected Countries of the ECAFE Region

Manufacturing Industries	Capital-Output Ratio						
	Taiwan	India	Republic of Korea	Pakistan	Philippines	Thailand	Japan
	1965	1963	1966	1960	1965	1963	1965
All Manufacturing	1.62	1.88	1.14	1.27	1.01	1.19	0.87
Food	1.60	1.55	1.39	1.49	0.95	2.50	0.79
Textiles	1.74	0.99	1.42	1.25	2.62	2.33	0.88
Paper and Allied Products	1.99	2.88	1.04	3.03	1.84	25.84	1.62
Rubber Products	0.92	1.07	1.19		0.83	0.30	0.50
Chemicals	2.43	2.00	1.12	1.25	0.67	1.32	1.08
Non-metallic Minerals	1.89	1.89	1.56	1.33	1.51	1.21	1.07
Metal and Metal Products	7.08	4.84	1.10	1.10	1.13	0.98	0.62
Machinery and Parts	0.95	1.47	1.47	0.87	1.06	1.17	0.70
Electric Machinery and Appliances	0.81	1.46	0.96	1.19	0.76	1.67	0.59
Transport Equipment	0.72	1.24	1.19	0.30	0.75	0.77	0.63

SOURCE: National Censuses of Manufacture

It is not generally true, in this sample at least, that the higher capital-output ratios are found among the more labor-intensive industries, neither in the large industrial categories of Tables 2 and 3 nor in the smaller subdivisions thereof. There are some strong examples of the opposite relationship [details omitted]. From a joint analysis of the capital-labor and capital-output ratios of the industries in the above countries, it was possible to identify some industries which combine the advantages of high labor intensity with low capital requirements per unit of output. Among such industries were: a large number of food manufacturing industries like rice-milling, edible oils, bakery and confectionery, dairy products, biscuit and ice-cream; textile industries like cotton, jute, wool or art silk, wearing apparel and made-up textiles; footwear manufacturing; saw-milling and plywood, furniture and fixtures, leather products, tobacco, non-alcoholic beverages, printing and book-binding, and matches; soap and glycerine, drugs and pharmaceuticals, perfumes, cosmetics and toilet paper; paints and varnish, plastic products; rubber, glass, tile and brick manufacturing, pottery and earthenwares; electric lamps, appliances and other electric goods, bicycles, heating, cooking and

lighting apparatus; hardwares, blacksmithing and welding; agricultural implements, and a variety of light engineering industries.

The argument that labor-intensive industries consume more capital per unit of output seems untenable. But another argument advanced against labor-intensive industries is that they are technically inefficient, that their costs of production are higher and their rates of return on capital lower than in capital-intensive industries. If this is true, it would support the argument that savings and reinvestment rates would be higher in the latter group of industries. The very fact that the labor-intensive industries continue to exist side by side with the capital-intensive industries and earn rates of profit adequate to keep them in business, is indicative of some advantages they may have over the capital-intensive industries. However, there has been little research on this subject. Some empirical evidence is available in a 1963 study undertaken by Dr. T. Y. Wu to find out whether the rate of profit varies with capital intensity and whether there is any statistical relationship between the two variables. He concludes: "From the census of manufactures in India, Pakistan and the Philippines, as well as the corporate statistics in Japan, the rate of operating profits by industry groups does not show any definite positive or negative relation with capital intensity. The hypothesis of increasing profit with capital intensity, therefore, may not hold true. . . . If the different factors of production and the products were revalued according to accounting prices, the various ratios would most likely become even more favorable to capital-light production."

An exploratory attempt was made to collect data on the relative profitability of selected industries in Korea in 1968, compiled from the "Financial Statements Analysis" published annually by the Bank of Korea. Two criteria of profitability were used: 1) ratio of net profit to net worth, and 2) ratio of profit to value added. By the first measure, all but one of the 16 labor-intensive industries covered by the survey had ratios of net profit to net worth higher than any in the eight capital-intensive industries. Using the profit/value added ratios, the labor-intensive industries had the most profitable cases and the capital-intensive group the least profitable, but most values in both groups fell in the middle range. In view of the serious limitations of the accounting data, these results are more suggestive than conclusive. However, corroborative evidence of the profitability of labor-intensive activities can be found in the financial and operating ratios in all the 50 small-scale (labor-intensive) industries in Korea for 1968. In all but two of these 50 industries the percentage ratio of net profits to net worth varied from 10 to 17—a reasonably good rate of return on the capital invested, and not very much lower than what one would expect from investment in capital-intensive industries. The other ratios, viz., operating cost ratio, ratio of operating profits to working capital and the ratio of net profits to net sales, also tend to support the gen-

eralization that the rate of return on invested capital is not necessarily higher, nor are operating costs lower, in capital-intensive than in labor-intensive industries.

Employment-Oriented Industrial Strategy

There is a growing recognition that one of the areas in which there is urgent need for further intensification of national development efforts is that of securing full, productive employment for all those who are available for and seeking work. Realizing the great challenge posed by mounting unemployment and underemployment, Asian countries are quite anxious to evolve and pursue a policy designed to promote economically sound, socially desirable and production-oriented employment. Industrial planners are interested in formulating employment-oriented industrial policies that could bring about mutually reinforcing increases in output, employment, and incomes. The broad framework of an employment-oriented industrial strategy should, I believe, include vigorous, sustained and concerted measures for:

1. Fuller and more efficient utilization of idle capacity in manufacturing. A number of surveys in India, Pakistan, Taiwan, Indonesia, Ceylon and the Philippines have shown extensive underutilization of capacity in large segments of industry.

2. Reducing the capital intensity of industrialization through:

   a) promotion of labor-intensive manufactured products; and
   b) application of economically sound labor-intensive techniques of production.

3. Rapid expansion and promotion of technically sound and economically viable small-scale and cottage industries that could secure simultaneous increases in output, employment, savings and investment. Such industries should be suitable for dispersal in rural areas.

[Excerpted from Employment Aspects of Industrialization With Special Reference to Asia and the Far East, unpublished mimeo report, 1970, pp. 3-4, 8-9, 23-26, 33-36, and 40-49.]

Toward Full Employment in Colombia—Industry

Inter-Agency Team organized by
the International Labor Office (ILO);
Dudley Seers, Chief of Mission

[For a full employment strategy to succeed in Colombia, industry must provide new jobs at a rate much faster than before. Some ways of bringing this about are: raising the income share of the poorest people, seeking and using more labor-intensive technologies, removing anti-employment biases from financial incentives, and reshaping some aspects of the labor market.]

Without rapid growth in the industrial sector, the Colombian economy will not be able to solve the employment problem. Notwithstanding the efforts made in the rural sector to offer more employment, there are limits to the expansion of agriculture—and these limits will become more severe as the available spare land dwindles. [See Development Digest, January 1971, pp. 114-124 for the authors' proposals for employment strategy in Colombian agriculture.] It is manufacturing that will have to provide the increasing exports needed for a sustained growth of employment, and it is only in this sector that the battle to free the Colombian economy from an excessive dependence on imports of capital and intermediate goods can in the end be won. More specifically, the manufacturing sector will have to absorb a bigger proportion of the labor force, and this means that its rate of expansion must be much faster than during recent years, and that the number of jobs it creates per unit of investment must be higher.

In developing a full employment strategy for Colombia, in which the overall target is the creation of 5 million additional jobs by 1985, the role of industry may be described as follows. Taking the modern sector first, our starting point in 1970 is the 310,000 employees of whom 41 percent work in consumer goods industries,

33 percent intermediate goods, and 26 percent capital goods. The need is for over 720,000 workers in the modern sector of manufacturing by 1985, so the rate of growth in employment would have to average nearly 6 percent per year; with output per worker increasing by 3 percent, this would require a big increase in the rate of growth of production—to over 9 percent. Such a rate of growth would be possible provided firstly that other sectors, taken together, grew at 8 percent (to create the necessary demand); and secondly, that the structure of industrial production changed to include a larger component of investment goods. Even with this growth in output, the necessary increase in employment could not be achieved without some decrease in the rate of growth of production per man-year, which has exceeded 3 percent in the past. This means a decrease in the capital/labor ratio, through the more rapid expansion of labor-intensive industries and the use of higher proportions of labor in industries where technological constraints do not make this objective anti-economical.

In addition, there were approximately 320,000 people working in handicrafts in 1970, with an output of approximately 1 billion 1958 pesos—compared to 7.4 billion in the modern industrial sector. Even with the increased abosrption of labor by modern industry, we believe it will be necessary to plan also for a considerable increase in the number of handicraft workers. What seems to be indicated is a figure of the order of 740,000 employees in 1985, and at a higher level of living. This would mean an annual rate of increase in employment of nearly 6 percent; with labor productivity increasing at 2 percent, output would have to grow by nearly 8 percent per year. It would be difficult to reach full employment with much less than this. All these are of course hypothetical figures, used to illustrate the magnitude of the task ahead in the industrial sector, and to introduce the following proposals concerning the general path which a process of intensive industrialization could follow. [Details on projections for industries omitted.]

Income Distribution

There are many links between levels of employment and the distribution of income. In economies where the rates of unemployment and underemployment are high and rising—as in Colombia—to achieve a higher level of employment is to redistribute income; it is in fact the most feasible way of providing the poorest groups of the population with the opportunity to obtain a larger share of the total. A policy of full employment is the first and most effective component of a program to eliminate extreme poverty.

What is the present shape of the income distribution in Colombia? Little reliable statistical information exists about the patterns and trends of income distribution, but several overall estimates have

been made, and in 1969 two carefully executed studies of urban and rural incomes were undertaken. In spite of the qualifications one may have about the data, one fundamental conclusion clearly emerges from all the information available, namely that income in Colombia is heavily concentrated in a very few hands. It also appears from other sources (but less definitely) that, on the whole, this concentration of income has not lessened during the last 15 years: it might even have increased. Whichever estimate is taken, the poorest 50 percent obtain only about one sixth of all income, while according to the most recent estimates, the 5 percent of the population with the largest incomes receive between one third and two fifths of total income. The concentration of income among the very rich seems to be much greater in agriculture than in the urban centers. Further, the degree of inequality of income in Colombia is apparently not much modified by the tax system. On the basis of rough estimates, distributions of income before and after taxes in 1966 were practically the same, the "progressive" nature of direct taxes being more or less balanced by the "regressive" incidence of indirect taxes.

Employment policy cannot be properly discussed unless we mention some of the most important causes of this concentration of incomes. The first is the extremely unequal distribution of property. The highly skewed distribution of agricultural income must derive essentially from the heavy concentration of land holding. The distribution of company shares is also heavily concentrated: a mere 0. 2 percent of shareholders (themselves a very small group) own 61 percent of all shares. Other factors are the highly uneven access to the higher levels of education and to employment in the modern sector. In developing countries, where the general level of education is low and where there is a dual economy with modern and traditional sectors, the distribution of income from work is also very uneven. Relatively very high incomes (sometimes high also in absolute terms) are received by professional and technical personnel, by highly skilled workers, and by the small fraction of unskilled laborers who work in the modern sector. The probability of a person reaching the highest levels of education or of entering the modern sector is strongly correlated with his family's income, so that those with high incomes from property are also more likely to obtain higher incomes from work.

Employment effects. The main way in which income distribution affects the level of employment in Colombia is through its effect on the pattern of consumption. This works through the different import content of the expenditures of the rich and the poor, and also through the different direct labor content of those expenditures. If we assume that the tendency to consume imported products is higher among the rich than among the poor, then the greater the degree of inequality in income distribution the higher the demand for foreign goods, and less foreign exchange is left for the capital goods and intermediate

products needed to expand employment. It was not possible for us to determine the statistical relation between these tendencies and the level of income; at first sight they do not seem to differ greatly between rich and poor because consumer goods imports are only one percent of total consumption. There are, however, three reasons for doubting this conclusion. The first is the large amount of contraband imports of a luxury character; the second, the volume of tourist expenditure; and finally the larger import content of the more luxurious domestically produced consumer goods. If our reasoning is correct, one of the direct consequences of a more equal distribution of income would be the reduction of the pressure on the supply of foreign exchange now being used to finance contraband, tourism and foreign inputs for the domestic production of non-essential consumer goods. The scarcity of foreign exchange has been in the past and is likely to be in the future a major constraint on the process of capital accumulation and hence on the rates of growth of both output and employment. So all measures which, like the redistribution of income, increase the amount of foreign exchange available for purchase of imported investment goods permit an acceleration in the growth of capital accumulation and therefore also in the rate at which jobs can be created in the longer run.

A more direct link between equality and employment is that the basic goods which are widely purchased by those on low incomes—essentially food and rather simple manufactures like clothing and footwear—are precisely the goods which are (or can be) produced with techniques considerably more labor intensive than those used in the production of the goods demanded by the rich. To produce the latter usually requires high capital intensity. A given amount of income will thus generate more employment when spent in the purchase of wage goods than in the acquisition of consumer durables. Since, broadly speaking, these goods for mass consumption can be produced with simple techniques, the greater the increase in their sales the greater the demand for unskilled labor which is in particularly ample supply. There is a further link: since the poorer classes spend a high proportion of their income on food, the bigger their share of total income, the greater the demand for agricultural goods, and the greater the check on the pace of urbanization and the investment requirements for urban infrastructure—a check which we believe would help a full employment strategy.

It can be argued that, although a highly unequal income distribution may harm employment in the short run for the reasons noted, it may help it in the long run by providing the savings needed to buy the capital equipment that makes higher employment possible. There are, however, some reasons for thinking that this argument does not carry great weight in Colombia. Notwithstanding the extreme degree of economic inequality that has prevailed, total personal savings

appear to be quite low. Data on savings are notoriously unreliable, but for what they are worth, they show such savings averaging 2 percent of total income in the period 1961-67. The owners of latifundia in particular appear to be keener on maintaining high standards of consumption than on accumulating funds to develop their properties. Secondly, it must be noted that even if a highly uneven distribution of income did induce a higher rate of personal saving, it is not obvious that Colombia would benefit. To a considerable, but unknown, extent savings flow abroad; if the distribution of income became still more unequal, this would give more income to potential exporters of capital, and the change might well be accompanied by greater unrest which would further stimulate the outflow of capital. Finally, if a more regressive redistribution of income did lead to higher levels of both savings and domestic investment, it is not evident that employment would rise. The rich will at best save only part of any increase in their income, so a still higher concentration of income in their hands would tend to raise the demand for sophisticated consumer durables and for foreign travel. This shift in private consumption would, on the one hand, increase the import content per unit of expenditure and, on the other hand, raise the capital requirements of employment. With both these changes acting as limitations on the expansion of employment opportunities, the benefit from a higher rate of capital formation would be partly, or more than wholly, lost.

Finally, there is the incentive argument. Some mechanisms are certainly needed in any society to ensure that people making different contributions to the production of goods and services also obtain different rewards. But we question whether the high degree of economic inequality that actually exists in Colombia is needed to induce adequate responses from the population in effort or self-improvement, any more than in saving.

Changing the distribution of income. Direct taxation at rates rising with income levels is the most straightforward means of dealing with income distribution. Personal income tax supplies in Colombia about one third of the total tax revenue of the central government, a rather high proportion by Latin American standards—though this revenue is a relatively small percentage of gross national product (GNP). But only a small proportion of total income is subject to direct taxation at all. Eliminating some special exemptions and reducing others would bring a substantial increase in revenue without any change in rates, and some of the more notorious cases of tax evasion which still exist could be brought under control. An outstanding example in this respect is evasion by farmers, and a practical way of drastically reducing this has been suggested by a Commission on Tax Reform in 1968 by making "presumptive" assessments of income where declarations are ridiculously low. The property tax is the other direct tax which offers possibilities for increasing both government

revenue and equity. Greater economic equality can also be brought about using indirect taxes and subsidies to change the relative prices of the goods, taking advantage of the great differences between the consumption patterns of the rich and the poor. There are big opportunities for changes of this type in Colombia. The present sales tax hardly discriminates at all against non-essential commodities—the top rate (levied on producers', not retail, prices) is only 15 percent. The changes proposed in the most "progressive" alternative put forward by the Tax Reform Commission would raise the basic rate from 3 to 7 percent and the one applicable to luxuries from 15 to 60 percent. Something of the sort is inevitable if the government is going to be able to finance a full employment strategy.

Fiscal measures alone would hardly bring about a fundamental change in distribution, however. Economic inequality results mainly from the very high concentration of property and the existence of great differences in the degree of access to the educational system enjoyed by children of different economic backgrounds. There are three basic ways of removing these fundamental causes of inequality: land reform; programs in education, health and other social fields; and monopoly control policies. Land reform (discussed elsewhere) would have its industrial employment effects chiefly through influence on demand. Increasing the educational opportunities for poor—especially rural—children could improve the industrial labor supply, and would in any case be politically popular, offsetting some of the more unpopular items in the employment strategy. Monopoly control is the approach needed within industry.

Because of economies of scale and the relatively small dimension of the market for most industrial products, competition in industry is much weaker than in agriculture. In many industries a few large firms enjoy a power close to, if not actually, monopolistic. This is buttressed by high tariffs and direct controls on imports which practically eliminate foreign competition. The result is not merely high dividends (and high profits for the self-employed) but also relatively high wages in a few favored industries. Apart from aggravating the distribution problem, the pattern of investment is seriously distorted. The danger is that established, capital-intensive modern industry will capture the whole of the domestic and export markets, so the facilitation of broader based, more effective competition is important. In some industries, however, the combined implications of technology and market size are that production should be concentrated in a small number of plants (often only one) and in such cases the crucial policy need is not the multiplication of production units but the control of monopoly profits. At the same time care should be taken not to impair the machinery for generating corporate savings, which have an essential role to play in an economy which relies primarily on private enterprise for industrial progress and employment.

We believe that a Tariff Board should be set up to examine the need for extremely high import tariffs. Such a Board should also make recommendations on import licensing, since this is merely another form of hyper-protection. Secondly, firm application of anti-monopoly legislation by the Superintendencia de Sociedades Anónimas is necessary.

Labor-Intensive Techniques

Levels of employment can be raised not only by improving the pattern of demand but also by producing things in more labor-intensive ways, i. e., by changing the methods or techniques of production so as to use more labor in meeting any particular pattern of demand. It is clear that in Colombia labor-intensive techniques have often been abandoned, and more capital-intensive techniques adopted, for reasons quite apart from shifts in demand—some reasons being defensible, others not. If employment is to be raised at a faster pace, the justification for capital-intensive techniques must be looked at very critically.

The first point to be stressed is the very wide range of economic activities involved in the question of labor or capital intensity. Economists often refer to the problem of "choosing techniques," as if the choice was always between using different proportions of men and machines in manufacturing well-defined products. In fact, the choice of using more labor or more capital is embedded within decisions concerned with systems of farming, the choice of building materials, organization of the health service, repair and depreciation rates of all types of vehicles and machinery, maintenance of stocks and inventories of all sorts. Such choices arise whenever there is more than one way of doing things, whether we are choosing from among the latest machines and technological know-how, or considering ways to roof a house, sharpen a knife or cure some common ailment, e. g., by herbs instead of manufactured (possibly imported) drugs.

Four generalizations can be made about this whole area. First, because of the multitude of sectors, factors and options involved, there is more flexibility of choice than one might think if one focused only on modern manufacturing. Secondly, for various reasons the choices actually made by government departments, firms and individuals in Colombia in recent years have been subject to systematic biases, away from labor-intensive and towards more capital-intensive techniques. Thirdly, though individually many of these choices may have had little effect on employment, the cumulative effect of biased decisions over the whole field probably accounts for a good part of the slow growth of employment in relation to output. Fourthly, for the same reasons, policies to reverse these biases must become a major part of employment strategy in the years ahead.

The strongest biases arise from the domination of the "developed" countries over technological research and development. In recent

decades the vast bulk of research, invention and innovation, in all fields, has naturally been pioneered to meet the needs of the already industrialized countries where it was undertaken; in particular the whole body of this work reflects strong and pervasive pressures to produce high-volume methods which are ever more labor-saving. The result is that the bulk of new techniques, designs, materials, skills, organizational methods—even academic theories pouring into the world incorporate within them an inherent bias against the use of labor.

Other biases arise from within Colombia itself. Often technological options exist but effective choice has been limited by lack of knowledge or by restrictions on their use (e. g., where there are monopolies) or by socially determined preferences for the new imported technique. Consumers—and the government—often, in effect, encourage the tendency towards capital-intensive methods, by their preference for standardized products, rapidly produced by large-scale industry. One thinks particularly of the mass consumer goods which increasingly take the place of more traditional, locally made versions of similar products. These changes in demand are not entirely spontaneous; they are in part promoted by the advertising and sales campaigns of the big companies, and in part influenced by waves of fashion spread through the mass media, and their employment costs must be carefully considered. Handmade, traditional products, which create much more employment, rarely get advertised.

In Colombia, the implications of a technological policy for industry taking account of the employment aspects, and of the need to use the available factors of production in a rational way, has received up to now very little attention from either government or the private sector. It has been widely assumed that all imports of machinery were a good thing for the economy, and that the adoption of any modern technique was desirable. In consequence, imports of machinery have tended to receive preferential treatment in the tariff structure and in the granting of import permits, without due consideration to their employment implications. If to this is added the effect of periodic exchange overvaluation, the relatively low interest rates, and the easier access to credit enjoyed by large modern companies using capital-intensive techniques, we have a composite picture which, besides discouraging the development of a local capital goods industry, tends to make it easy and cheap to buy machinery. Further incentives to mechanization arise when labor costs are unduly high [see discussion below]. Our impression, after visiting the main industrial centers, is that a substantial economy in investment could have been made if policy on imports of machinery had followed more selective criteria. One clue is given in Table 1. If one takes the installed horsepower per worker as a basis for comparison, Colombia's degree of mech-

anization is 50 percent higher than that of the less advanced developing countries and comparable with that of the more advanced. These figures have to be cautiously interpreted, but they hint at the need for a critical review of past policies, especially since there are reasons for believing that there is general overcapitalization in the countries being used as a standard of comparison.

Table 1: Mechanization by Groups of Countries, in About 1963

(HP/per employed person)

Industrial Branches	Advanced[1] Developing Countries	Some Other[2] Developing Countries	Colombia
Total industry	3.0	2.2	3.3
Food	3.6	3.1	3.6
Textiles	2.1	n.a.	3.0
Clothing and footwear	0.4	0.2	0.3
Furniture	1.5	0.8	1.3
Leather	2.4	1.8	3.8
Metallic producers	2.2	1.6	2.6
Non-electrical machinery	2.4	1.8	2.3
Electrical machinery	1.3	1.0	1.5

[1]Spain, Greece, Israel, Mexico, Brazil, Argentina, Chile, Hungary.

[2]Taiwan, Korea, India, Paraguay, Panama.

SOURCE: United Nations: The Growth of World Industry 1953-65, National Tables. Document ST/STAT/SER. P/4.

Intensity in the use of capital differs from industry to industry, and also according to the size of plants. Handicrafts in Colombia cannot be said to use capital-intensive techniques; their problem—and that of small industry generally—would be, rather, the need for better techniques, involving more machinery, in order to increase productivity and competitiveness. In medium-size industries, too, the danger of oversophisticated techniques is not very real and no examples of it were found by the mission. In any case, labor intensity in industry is not an objective which should be purused at any cost, forgetting the need to maintain standards of quality, or capacity of competition in foreign markets, etc. Especially now, when there is the imminent prospect of Andean integration, foreign competition is a very important element in the picture, and Colombia will need to extend import substitution into fields such as capital goods and intermediate products.

Provided that wage levels and costs of capital are not misleading, the problem which arises is discovering and applying the most appropriate techniques in each industry, a task which has been receiving increasing attention from the Colombian planning office. The capacity of Colombian industry, or of Colombian engineering science, to create technologies of its own which use more labor is as yet very limited, although we saw some cases in which great ingenuity has been used. So the issue is, in the first place, how to find the necessary information on techniques used in other countries. Colombia does not

have at present much knowledge about techniques other than those used in the United States or western Europe. A set of relationships has developed with relatively few suppliers of machinery in countries where volume of output is typically very much higher than in Colombia, and factor costs are very different. It will be a big task to reduce ignorance about alternative technologies. Some national agency needs to be given the task of establishing a program of research, starting with a field study in an industry with some export potential. The Andean group might well form an institute to share the costs of such expensive work. International organizations could also help, especially the United Nations Industrial Development Organization (UNIDO) and the Organization of American States (OAS). This is not only a problem of selecting the most appropriate technology; for it to be applied, consulting services are needed by those planning investments and expansion.

Influencing Techniques Through Financial Policies

The private sector of the economy, by and large, tries to maximize profits by choosing techniques which give lower costs, as it sees them. Decision-makers in the public sector, although pursuing other aims, should not, and often do not, disregard the financial costs of different methods of production. Yet the techniques thus chosen may not be the most appropriate from a social point of view, taking unemployment into consideration, and inappropriate techniques will continue to be used unless project evaluations are based on the "social" costs of resources. One line of solution is to bring market prices closer to social costs. What this implies in an economy like that of Colombia, with surplus labor but capital and import constraints, is that the cost of using investment goods, in particular imported ones, should rise in relation to the price of labor, in particular of unskilled labor. Attention is focused here on the cost of equipment, the cost of borrowing and depreciation allowances, since these can be influenced by government policy; the decisions on technology, we assume, will be made by private business without direct regulation.

Exchange rates. There have been times in recent Colombian history during which exchange rate, tariff and direct import control policies lowered unduly the relative price of foreign investment goods. One effect was to encourage the adoption of excessively capital-intensive techniques. Sometimes exchange rates were left constant for long periods, while the price of labor was rising more or less in step with inflation—and in the modern sector faster. This, by itself, must have particularly stimulated excessive purchases of imported capital goods in anticipation of the next, eventually inevitable and big, devaluation. Following the exchange reform of early 1967, the previous policy has been replaced; under the new system of frequent but small deval-

uations, the authorities have let the (multiple but coordinated) rates rise at a slightly faster pace than the internal price level. At the same time, international prices of machinery and equipment have increased because of the acceleration of inflationary trends in the industrialized countries. This combination of trends, besides having contributed to an improvement in the balance of payments, must also have helped to raise the relative price of imported equipment. We believe that the present system is the right one.

Interest rates. In the long run, unduly low interest rates may, by penalizing savings, act as a brake on the rate of capital formation, outweighing the stimulus to borrowing that they seem to provide. From the point of view of employment, the result of too low interest rates can be doubly harmful: capital investment can be discouraged, and what investment there is tends to bring labor-saving technology. Although interest rates in Colombia seem high, they are actually artificially low. With inflation averaging over 8 percent in recent years and with price increases of this magnitude expected for the immediate future, savers are getting a negative return on the funds they have channeled into time and savings deposits; this is hardly a way to promote greater savings. When corrected for inflation, most of the lending rates seem also quite low for a country where capital is scarce. The excess demand for credit at these rates is met by rationing the available supply of loanable funds. In these circumstances, banks naturally favor large and well-established firms. They are "better risks," and even if this were not so, it is much easier to administer a few, large loans—apart from any political or social pressures there may be on a bank manager to provide highly valuable capital to big firms. Thus, besides encouraging indirectly an unduly high degree of mechanization, low interest rates are likely to cause funds to go precisely to the firms most likely to use capital-intensive techniques. Another result is to strengthen monopolies. Many small entrepreneurs told us that they had great difficulty in obtaining investment or working capital.

These problems would be eased if interest rates were increased. Probably of greater consequence is that while loanable funds are so scarce that they are in effect at the discretion of bank managers, this discretion should be used to steer them much more towards the priorities of an employment strategy, viz. to provide capital to small firms using labor-intensive techniques.

Taxation. One obvious way of influencing the cost of equipment would be by eliminating the general exemption from duty that much imported equipment enjoys—which amounts, in the circumstances, to a virtual subsidy. Tariffs on equipment would have the additional advantage of stimulating local production of capital goods. Moves in this direction should however be cautious, partly because a big rise in such taxes might disrupt the development plans of business, and

partly because there would be a real danger of creating still more pockets of overprotected monopoly, to the detriment of the long-run competitiveness of all forms of production in international markets.

A more useful instrument is the provision for depreciation in tax regulation: the more generous and flexible depreciation allowances are, the more profitable the use of capital-intensive techniques will be; conversely, to allow capital to be depreciated over a longer period than the true life of the equipment, or to make no allowance at all for depreciation, encourages labor-intensive techniques. We do not think that this can be done safely in sectors subject to international competition. But such a measure can and should be used to increase the capacity to absorb labor of two sectors, construction and services, where the technical possibilities allow rather wide ranges of choice and where the techniques chosen may well be influenced by such a change. Depreciation allowances can also be used as a positive incentive to encourage fuller utilization of existing capacity by giving special allowances to firms operating multiple shifts.

The other possibility is to look for general ways in which the powerful weapon of fiscal incentives could encourage the use of labor, especially unskilled labor—though any such innovation must be administratively simple. This line of thought suggests the possibility of allowing a premium to be added to the wage bill before the latter is deducted from sales proceeds to arrive at taxable income; to avoid subsidizing wage increases, the amount of the premium could be calculated by multiplying the number of full-time employees by some standardized wage figure.

Wages Policy

In the employment strategy recommended here, wages and salaries play a crucial role in three main respects. First, they have a direct bearing on the choice of techniques; where employers can readily mechanize, the objective of wage policy should be to avoid furthering this. Second, wage and salary costs affect to some extent the expansion of exports. It would be desirable, therefore, to avoid increases in wages that would cause opportunities for exports (or import substitution) to be missed. The third area is that of rural development strategy. Problems of production techniques occur also in agriculture, especially on modern commercial farms; moreover, wage costs affect how much work can be done for the improvement of the rural infrastructure (roads, water supply, etc.) within a given budget for public works, and consequently how many people will be employed.

By and large, we have taken the view that big increases in employment can be attained more easily if large increases in wages are

avoided. On the other hand, while a man's choice of occupation and of the place where he works (rural or urban) are by no means exclusively or primarily made on grounds of salary, it will be easier to fill gaps in skilled manpower if salaries can rise fastest where the difficulty of attracting qualified applicants has been greatest. It might be felt that all these are cold economic considerations, oblivious of criteria of equity in the distribution of income, and without any regard for the need of workers. But there is one decisive consideration: the surest way of improving the lot of the poorest groups of the population is through an active policy for abolishing unemployment. It is more urgent to provide work for those who have none than to improve the conditions of employment of those who already are in work, especially those with relatively high wages.

Wage fixing in the private modern sector. At present, wages and other social benefits in modern manufacturing are relatively high. They may well be three times as high as wages and other benefits in traditional craft-manufacturing and agriculture. This differential is mainly the result of a fast increase during the period 1955-63, when real wages in modern manufacturing nearly doubled and those in craft-manufacturing and agriculture rose little, if they did not actually fall. Wages in a number of industries in the modern private sector are fixed by collective bargaining, in a somewhat special legal and economic framework. The law gives organized workers several bargaining advantages, notably the right of a majority of workers in an enterprise to strike and to exclude non-strikers from work. Such legal advantages are not uncommon in Latin America, and there is much to be said for them in conditions of widespread unemployment where the position of trade unions is weak. A second feature of collective bargaining in Colombia is that many firms in this sector occupy monopolistic positions due to the smallness of the market and protection from foreign competition. Collective wage bargaining thus often takes place in a state of near-isolation from the general condition of the employment market in which there may be much unemployed labor willing to work at lower wages. This isolation, together with the employers' power to add wage increases on to prices, has certainly strengthened the bargaining position of the trade unions, and it partly explains the high rate of wage increases in the past in the modern sector of the economy. It might well cause similar rises in the future, and further widen the already substantial income inequalities among wage earners (especially between urban and rural workers) while limiting the growth of exports essential for the employment policy recommended here and probably hampering the growth of employment in modern manufacturing itself.

These considerations might lead some to argue that a reduction in money wages is needed, but such a course must be ruled out as politically unfeasible. We recommend that during the next few years at-

tempts should be made to avoid increases in the general level of money wages in this sector which would greatly exceed rises in the cost of living, even if there were big increases in productivity. But this would not, of course, exclude raising individual earnings, for instance where systems of payment by results are applied. We would not favor direct government control of wage settlements or changes that would alter the legal rights of trade unions. Rather, ways should be sought of undermining the monopoly power of employers to pass wage increases on in the form of higher prices.

A number of methods are possible. One is direct intervention by the administrators of the anti-monopoly legislation, who might announce that if an employer engaged in wage negotiations likely to result in large increases, and afterwards raised his prices, the authorities might have to examine whether this constituted abuse of a monopolistic position. Another is to relax temporarily, or threaten relaxation, of an industry's tariff or quota protection when collective wage negotiations threatened to result in an undesirably high settlement. In a country like Colombia, where employers need licenses for various purposes from national and departmental authorities, there are no doubt other ways for the latter to express displeasure at price and wage increases that are harmful to the public interest in a successful employment policy. Also, prices of individual products could be controlled directly. Application of some or all of these methods of stiffening employers' resistance to wage claims would not reduce the scope for collective bargaining, a highly prized procedure in Colombia, nor impair the legal rights of unions. But they would create conditions in which the results of collective bargaining approached more closely the optimum for society as a whole, and thus help to develop a sense of public responsibility on the part of both employers' and workers' organizations. This policy should be supported by those responsible for mediation and arbitration.

Wages in handicrafts. Total employment (including the self-employed and family workers) seems to be both larger and rising faster in craft manufacturing than in the modern sector. Collective bargaining and trade unions are virtually non-existent in the handicraft sector. It is a key part of our proposed employment strategy that craft manufacturing should remain a major source of productive employment through gradual expansion and modernization. With increasing productivity, it should become possible for incomes in this sector to rise; but for the time being, it would seem undesirable for big rises to occur in the level of real wages. We recommend that, as long as unemployment and underemployment in Colombia have not been considerably reduced, minimum wage regulations should not go much further than adjusting rates to increases in the cost of living.

Labor Law and Working Hours

Throughout our stay in the country, our attention was continually drawn to some features of Colombia's extensive Labor Code which were thought to discourage the growth of employment, especially in the private modern sector. The provisions most frequently mentioned were those concerning dismissal: once a 60-day probationary period has elapsed, an employed worker cannot be dismissed except for "just cause." This issue has often to be decided by a labor court, and if the latter does not find a just cause the employer must pay a large indemnity. Furthermore, the Labor Code provides that "collective dismissals," temporary or permanent, must be approved by the Minister of Labor. These are rather stringent conditions, even by Latin American standards. It was our impression that a great deal of uncertainty prevailed among employers as to the meaning of "just cause" and that, as a result, many felt that recruitment of a worker involved such considerable risks that it was to be avoided if possible. No official definition exists of "collective dismissals" either, and there is uncertainty in practice. We are in basic agreement with the principle of legal protection against arbitrary dismissal; but it would seem that Colombian legislation and its application have created a situation where such protection has become a significant obstacle to increasing employment. In Colombia a job is now a very precious asset; it has been observed that jobs are "carefully rationed among the friends and relatives of current job-holders."

There are various ways in which employers can cope with these provisions; for example, employers may engage workers not as employees but on contract, which removes their protection by the Labor Code. In practice, however, the result of the limitation of recruitment very often means meeting the needs for increased production by overtime work. It is our strong impression, confirmed by some statistical data, that there is a great deal of overtime work in Colombian industry (and government) and that in recent years it has been increasing. For instance, in a week in September 1969, fully 18 percent of employees in Bogota worked 64 hours or more. When unemployment and underemployment are as widespread as they are in Colombia, this seems to us a thoroughly undesirable situation.

We feel, therefore, that measures are called for to remove, or substantially reduce, some of the existing factors which discourage recruitment of new workers and encourage employment of existing staff overtime, engagement of contract labor, and use of labor-saving equipment. Thus, it might be announced that collective dismissals would in general be approved if there was a fall in production— "in general" because the Ministry of Labor would need to ensure that an employer was not using a pretext to get rid of people for other purposes. In the case of individual dismissals, it would be desirable

if lack of work in the enterprise were to be included as the most important type of "just cause." If employment is to be encouraged, employers need a high degree of freedom in adjusting their labor force to varying current needs. But we do not intend that workers should be dismissed without notice, and without means of support while looking for another job. Rather we suggest that, if some of the main limitations of employers' freedom to adjust their labor force were removed, some form of unemployment compensation should be introduced on behalf of workers dismissed after having served for some time in a particular firm.

Deterrents to shift work. The two main provisions that discourage shift work are the requirement of a 35 percent premium for work between 6 p. m. and 6 a.m. and the prohibition of female work between 10 p. m. and 5 a. m. Although the evidence is somewhat conflicting, our impression is that these provisions are serious obstacles to shift work in industries such as textiles and apparel-making, which must play an important role in the Colombian export program, and in which international competition is very strong. Many countries have decided that under modern conditions night work for women does not present the moral hazards that may have existed two decades ago. We see no obvious need for ruling it out by law.

Hours of work. When much of the urban labor force works abnormally long hours, one simple way of increasing employment would be to reduce average working hours and thus to share the total employment among a larger number of workers. In a growing economy, shorter hours can be, and usually are, combined with rising productivity and incomes. Indeed in the longer run, this traditional demand of wage earners to reduce the working week will no doubt be pressed by their organizations. A gradual reduction of the standard working week from 48 to 40 hours by 1985 should be part of Colombian employment strategy. Working hours of the self-employed cannot be as easily regulated as those of the employed. Besides, reducing the hours worked by some of those working more than 60 hours a week on very small incomes in the handicraft sector would not offer any real opportunity for increasing employment. Nevertheless, it is clearly paradoxical to find so much overtime when there are so many unemployed. In all government services overtime should be reduced to the minimum, and in the private sector a minimum overtime premium could be fixed by law at 50 percent of basic time rates.

[Excerpted from Towards Full Employment. Geneva: International Labor Office, 1970, pp. 107-110, 139-161, 167-170, 175-193 and 199-210.]

Industrial Development and Employment in Iran

John R. Hansen

[Iran's industrial expansion has been unusually successful in providing new jobs at a 13 percent annual rate of increase, about as fast as the growth in output. This is unlikely to continue as the capital requirements per job are rising, but there are ways in which the employment-generating aspects of industry can be strengthened in future.]

Iran's industrial sector has been growing in real terms at roughly 13 percent per year during the past decade, and unlike the experience in many developing countries, industrial employment has grown at about the same rate. In other developing countries the growth of manufacturing output has generally been one-and-one-half to two times higher than the growth of employment in manufacturing. Table 1 shows the growth of employment and production in Iranian industry from 1962/63 to 1967/68 and its distribution among the major types of industrial activity; production is measured by the value added in manufacturing.

The non-durable consumer goods group (food, textiles, clothing, etc.) is still the most important in terms of employment and production, and it has contributed the largest share of the overall growth over the period—72 percent for employment and 59 percent for production. This is also the more labor-intensive part of Iran's industrial sector, as can be seen by the fact that it used 71 percent of the industrial labor force but produced only 64 percent of the industrial value added in 1967/68. Non-durable consumer goods, however, lost some of their relative importance since the rates

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of increase for intermediate goods and for capital goods—combined here with durable consumer goods—were more rapid in employment as well as in production. Their production has been gorwing by over 16 percent per year, about 3.5 percent faster than the sector as a whole; although they still account for only one fourth and one tenth of all Iranian industrial activity respectively, these shares are larger than in 1962/63. However, as one would expect, the growth of production is outstripping the growth of employment in these more capital-intensive activities.

Table 1: Changes in Value Added by Manufacture and Employment in Iranian Industry

	1962/63	1967/68	Five Year Increase	Annual Rates of Increase
Value Added (billions of rials)	34.1	62.8	28.7	5.7
Shares of Subsectors (percentages)				
Non-durable consumer goods	68.9	64.0	59.2	11.3
Intermediate goods	22.2	25.6	29.0	16.5
Capital/consumer durable goods	8.9	10.3	11.7	16.6
TOTAL	100.0	100.0	100.0	13.0
Employment (thousands of workers)*	249.7	461.5	211.8	42.4
Shares of Subsectors (percentages)				
Non-durable consumer goods	70.2	71.2	72.3	13.4
Intermediate goods	22.0	20.7	19.2	11.7
Capital/consumer durable goods	7.8	8.1	8.5	14.1
TOTAL	100.0	100.0	100.0	13.1

*excluding employers, working partners and unpaid family workers.

Some of the factors contributing to Iran's success in generating employment through industrial development include: first, a very large percentage of the firms in Iran are small establishments employing

less than 10 people, and these firms, which generally use a limited amount of capital equipment, have accounted for a large majority of the increase in industrial employment. Second, relatively labor-intensive industries including textiles, apparel, and assembly/packaging operations still account for a substantial part of Iran's total industrial activity. Third, the labor laws in Iran make it difficult for firms to dismiss workers who have been employed for more than a limited length of time. Fourth, the Iranian Government has assisted firms threatened with bankruptcy, especially those employing large numbers of workers, to avoid unemployment. Fifth, there is a policy in Iran to spread industrial development into the outlying areas. This policy is designed to encourage the development of new "growth poles." In these centers, new industrial establishments will develop, many of which will be relatively smaller and more labor intensive than the factories in Tehran, thereby extending employment opportunities to more of the nation's people without drawing them into the already crowded capital city.

While these policies have been relatively successful in maintaining employment growth in the past, future development of Iran's manufacturing sector is not likely to create employment at the same rate. Iran's past decade of industrial development has depended heavily on import substitution in the consumer goods field, the traditional area of "easy" import substitution. However, the country is now virtually self-sufficient in consumer non-durables; little more than 10 percent of Iran's imports today are in this category. Consequently, as opportunities for the development of new types of industrial activity in the field of consumer non-durables have almost been exhausted, new firms must increasingly enter the often more capital-intensive fields of intermediate and consumer durable/capital goods production.

In Iran today, and in most other developing countries, the simple workshop activities producing consumer goods and semi-services—such as carpentry, vehicle repair and garment-making—generally require less than $5,000 and sometimes less than $1,000 of fixed capital per job. Job cost in the assembly industries runs from $10,000 to $15,000 on the average. The textile industry, once regarded as the classic example of a labor-intensive industry, today requires investments in Iran of $30,000 to $40,000 per job. Although a petrochemicals industry based on Iran's rich reserves of oil could ultimately generate thousands of jobs, the cost will be high— probably from $150,000 to $300,000 per job.

The pressure to move into more capital-intensive industries because of domestic market saturation might be relieved in part by turning to export markets. However, expansion of employment through development of export-oriented industries will be difficult in Iran, as it is in virtually all developing countries. 1) Most countries of the

world, both developing and developed, have erected substantial trade barriers. These make it very difficult for the developing countries such as Iran, which are often comparatively high cost producers in the first place, to compete in foreign markets. 2) Iranian producers must compete in an international market which is often ruled by abnormally low or dumping prices. These prices are in part an inevitable response to the tariff barriers. Many manufacturers in the more developed countries can afford to export their excess production at prices below full cost because of various government subsidies and/or because they can count on sales in their large domestic markets to cover their fixed costs. However, industries in developing countries like Iran must generally recover their full costs of production on export sales, for the domestic market is too small to absorb a sufficient volume of goods to cover fixed costs. 3) Few businessmen in Iran have the knowledge, experience and contacts needed to market their products internationally. Selling abroad requires knowledge of foreign markets and foreign government regulations, establishment of sales and service networks, advertising, and the like, all of which take time to develop. 4) Many of the industrial licensing, financing, foreign exchange and protection policies in Iran often discriminate (though unintentionally) against export-oriented industries and in favor of industries producing for local markets. These policies are presently under intensive review by the government. Therefore, while an export orientation may well be an excellent long-term means of encouraging employment-generating industries in Iran, export industries take a great deal of time and effort to develop and cannot immediately meet the demand for additional industrial employment.

In sum, Iran has successfully shaped her past industrial development so that industrial employment has grown almost as rapidly, a phenomenon rarely found in developing countries. But the pressure of domestic market saturation in the more labor-intensive consumer goods industries means that Iran will need to pursue employment generation on several fronts to maintain its exemplary record in the future. Developing countries around the world could well take note, not only of Iran's past industrial investment pattern, but also of the possible future strategies open to Iran and other developing countries in the battle against unemployment.

Within the industrial sector, when the scope for production in the consumer goods industries has been filled, countries can look for those intermediate and capital goods products which are naturally more labor-intensive, thereby capitalizing on the plentiful supply of labor. Where there are alternative methods of producing a product, those which use relatively more labor would best help meet employment goals. Such methods will of course be attractive to industrialists only to the extent that hiring more workers can be made profitable. This depends in part on the productivity of the labor-intensive methods

and the wage rates that employers must pay, which in some cases in Iran have been driven above the marginal productivity. Labor-intensive methods would also be more attractive if employers were allowed to hire and release workers as necessary for efficient plant operation. The unemployment resulting from such layoffs could be made both shorter through retraining programs, and less painfull with unemployment benefits.

However, the selection of methods of production and types of products within the industrial sector should be made with an eye towards the requirements of the international markets, which Iran is rapidly entering. These markets require high quality, efficiently produced goods, so in the drive for more employment policy makers must never lose sight of the need for efficiency in the use of capital and materials. This can mean more production, lower costs, more sales, and consequently more jobs.

Since industry is almost universally the least labor using sector, industry cannot be developed at the expense of the agricultural and service sectors which traditionally depend more heavily on labor. Agriculture is often treated as a stepchild in development strategies by steering the bulk of the country's resources towards the more glamorous industrial sector; but a solid, growing agricultural sector is the backbone of a sound pattern of industrial development. Existing industries in countries like Iran cannot continue their expansion without raising the incomes of the urban and rural poor to expand the domestic markets for industrial products. Agricultural development programs now underway in Iran help the latter; the development of more productive service industries, such as skilled and reliable construction firms, could employ many of the urban poor, giving them the incomes to buy industrial products.

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Capital Utilization in Economic Development

Gordon C. Winston

[Despite capital shortages, industrial equipment is greatly underutilized in many developing countries. Analysis of Pakistani data for 1965/66 suggests that preferences for daytime work are an important underlying reason. Efforts to change these preferences could contribute substantially to economic growth.]

It is widely accepted that economic growth in underdeveloped countries depends primarily on additions to the stock of capital. There are qualifications and parenthetical comments that modify and flesh out formal descriptions of this process, but these are seen essentially as modifications to the still acceptable basic process of accumulation-investment-income-accumulation that has characterized development models from Marx through Harrod-Domar to Chenery. But if shortage of capital equipment is the major constraint to economic growth and industrialization, then it is a paradox of no small significance that in the typical underdeveloped country the existing stock of industrial capital is left idle most of the time. If installation of capital equipment does not lead to its use, then it is clear that savings and investment in physical capital cannot be the most critical aspects of development. Growth in product will be determined not only by the propensity to save-invest times a technologically determined marginal output/capital ratio (as in the Harrod-Domar model), but also by a percentage-of-utilization variable applied to capital stock—a variable which may shift rather widely relative to the effects of changes in the other growth determinants.

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If these are the effects utilization has on growth rates, how can the low levels of capital use found in underdeveloped countries be explained or justified? The available evidence suggests that in West Pakistan in 1965/66, for instance, the average industrial firm operated its equipment at less than 33 percent of its potential in a country where capital is assumed to be critically scarce. With few exceptions, capital utilization has been discussed only briefly and casually in the general literature of development, and neither hypotheses nor their implications have been tested. To list the most popular of the wide variety of explanations offered, the underlying cause of excess capacity has been found: in uncertainties of demand estimation, in scarcity of trained manpower, in anti-monopoly policies, in scale economies that recommend" building ahead of demand, " in rapid industrial growth itself, in the project bias of aid-giving countries, in financial capital outflows achieved through real capital imports and, importantly, in the consequences of an import substitution industrialization policy—in shortages of imported raw materials and import licensing policies. Diverse though these causes are, they all derive from errors in planning, accidental by-products of government policies or a type of technological determinism—in other words from inefficiencies and rigidities of one sort or another.

There is another kind of explanation for excess capcity, differing from these in that a low rate of utilization is seen as the result of perfectly sensible economic decisions by sensible people. An analysis of excess capacity as a consequence of rational investment behavior was developed by Robin Marris (The Economics of Capital Utilization, Cambridge, England: Cambridge University Press, 1964). The simple fact from which it starts is that people's normal preferences favor day-time work. To induce people to work at night, firms have to pay a higher wage—a shift differential in pay for the same work—so a firm faces higher total and unit costs for non-day-time operation. How much higher these costs will be will depend on the size of the shift differential and the level of real wages relative to other costs. It is assumed that there are alternative techniques of production in any industry; that higher capital-labor ratios are associated with higher labor productivity; and that entrepreneurs maximize profits.

Consider an economy operating with such cheap labor that it always pays to use plants with very labor-intensive techniques (hence low labor productivity) and to run them at high rates of utilization. The differential wage paid to shift workers might then be a considerable percentage of the day-time wage, but if that base day-time wage were low the cost of high utilization rates would be small. There might be known techniques of production that would increase labor's productivity by giving it more (better) equipment to work with; but so long as wages remained sufficiently low it would pay entrepreneurs to expand production by duplicating the low-productivity technique and then run it full

time instead of using limited resources to increase capital intensity and labor productivity. Suppose this economy were faced with a rise in the average wage rate, large enough that the original combination of technique and utilization would no longer yield maximum profits. There are two ways for firms to adjust to the higher wage (percentage shift differentials remaining the same): 1) reduce utilization so as to lower the average wage by paying a smaller part of the wage bill for higher-wage night work; or 2) increase labor productivity by giving labor more capital to work with.

Which of these is best for profits depends on the size of the shift differential and the cost of the alternative technology that brings higher labor productivity. If the shift differential were small, a good deal of output would have to be lost before the average wage was much reduced through a lower rate of utilization—a high "elasticity of utilization" in Marris' terms. Given the technological alternatives facing an industry, a high elasticity of utilization makes reduction of utilization an unattractive way to adjust to an increased average wage. The other way a firm may adjust to higher wage rates is to increase labor productivity, and an important difference in the sets of technological alternatives facing different industries is the ease (in terms of costs) with which a given change in labor productivity can be achieved. In one set of technologies a change in labor productivity might be had with a relatively small additional capital cost—a high "elasticity of mechanization"—while another set of alternatives may increase labor productivity only with substantially increased capital costs—low elasticity of mechanization. The higher is the elasticity of mechanization, the more likely is adjustment to higher wage rates to take the form of increasing capital intensity and the less likely that it will take the form of reduced utilization. Thus, the level of utilization and the level of capital intensity that will be optimal with any given wage rate will depend on both elasticities.

In addition to these two elasticities, technical characteristics influence utilization rates through economies of scale, not only in the lumpiness of plant size relative to the size of the market but in the internal balance of production flows between variously lumpy pieces of equipment within the plant. Further, the indivisibility of management over a 24-hour day afflicts, especially, the small firm with its Jack-of-all-trades management. Finally, costs of shift work, and hence utilization rates, are influenced by the intensity and distribution of people's preferences for or against night work. Preferences determine economic costs also in the management costs of night work and in the subjective costs of 24-hour-a-day responsibility that may be incurred by entrepreneurs.

Utilization of Capacity in West Pakistan

Examination of the structure of excess industrial capacity in West Pakistan had two aims: 1) to test its compatibility with the economic-rational analysis of capacity use, and 2) to determine the importance of other industry characteristics that influence an underdeveloped country. Data were collected by the West Pakistan Census of Manufacturing Industries (CMI) for 62 industries for 1965/66 and were aggregated into 26 industrial sectors for the analysis. Concerning the concept of capacity use: typically there is a wide variety in the number of shifts a firm considers normal, and the level of operation it therefore reports to any data-collecting agency as "full utilization of capacity." The question being asked here is why these standards of "normal" or "full" utilization leave capital idle most of the time—why there is so great a conflict between the presumed capital scarcity of an underdeveloped country and these entrepreneurial standards of correct capital use. The data were adjusted to reflect capital scarcity by taking two-and-a-half-shift operation for five days a week (100 hours a week) as the standard, unless the sector reported operating rates higher than that in which case actual operations were the standard. With this rather conservative estimate of capacity, average utilization was 33 percent; percentages for particular industries appear in Column 4 of Table 1 below.

There were four primary characteristics of an industry in West Pakistan significantly related to its level of capacity utilization (U). They are:

competing imports (M), measured as a percentage of total supply;
export sales (X), measured as a proportion of total domestic production;
capital-income ratio (K/Y); and
average firm size (S) measured as average annual production by the reporting firms in each sector.

These four characteristics explain a surprisingly large amount of variation in capital utilization between industries. Two other characteristics—market structure and labor productivity—were somewhat less influential but had, none the less, significant relationship to utilization rates. In a regression equation on percentage utilization of capacity that contained the first four characteristics, imports and capital-income ratio were significant at 99.9 percent, while exports and average firm size were significant at 99 percent; 81.52 percent of the variation in capacity utilization between industries is explained.

Competing imports. It is to be expected that imports would be related negatively to capacity use—imports compete, reducing demand for local products. But there is a quite reasonable negative relation-

ship on the supply side, too. If, as is typical, a developing country has followed an import substitution policy for a number of years it has (by definition) biased investment towards those industries with significant competing imports, and this would have led in time to more unused capacity in those industries.

Exports, too, can have an influence on capacity utilization that operates either through demand expansion or through investment and supply. Current exports add to current demand for the product, increasing capacity utilization. Past exports would have put an industry relatively in disfavor if investment planners were captured by the strategy of import substitution and its concomitant "export pessimism," a relative investment bias against export industries that would lead to high levels of capacity utilization. In both cases the relationship would be positive.

The capital-income ratio. The correlation between capacity utilization and capital-income ratio is positive and significant at over 99 percent. The most persuasive explanation is Marris': that it reflects profit-maximizing adjustments to prevailing wage, cost and technological patterns among industries. While we don't know the actual values for the elasticities, we would expect to find that those firms with higher capital-income ratios were also those that had had higher elasticities of mechanization in the past, hence have higher rates of utilization now.

Average firm size. Economies of scale undoubtedly play a major part in the significantly positive correlation between average firm size and capacity utilization. What sort of scale economies operate is not so clear—whether it is simple lumpiness of plant relative to demand, or the more subtle phenomena suggested above of equipment scale relative to product flows within the plant, or management scale—i. e., the reluctance of small owners to delegate night-time supervision to others. Other explanations for the correlation of size and utilization are also plausible: if high rates of utilization indicate efficiency, then efficient firms would probably have grown larger than the inefficient firms; or if political power is greater for larger firms—influencing decisions such as licensing of raw material imports (and if capacity use were constrained by their shortage)—then larger firms would operate at higher rates of utilization.

Market power. We might expect that competition tends to force higher rates of utilization, since firms with market power can substitute either inventory accumulation or excess capacity for price fluctuations when faced with demand fluctuations. Adding N, the number of reporting units in each industry, to our regression equation increased the value of R^2 to 0. 8641, with N significant at 95 percent.

Labor productivity. When added as a variable to the above equation with the four basic industry characteristics, labor productivity (L) is significant at more than 90 percent. What may appear curious is the negative sign of the relationship—the higher is labor productivity, the lower is the rate of capacity utilization, holding constant exports, imports, capital-income ratio and size. There are two reasonable explanations for this. The first supports the sense of Marris' model: in the hypothetical sequence used to describe his model above, the industries found to be operating at high utilization rates are those with low wage, low productivity labor. The alternative explanation is simply that in measuring value added per unit of labor we have inevitably measured labor skills, and these skills are in critical shortage, limiting capacity use even though, in a traditional labor surplus economy, their shortage is not fully relfected in differential wage rates. This is consistent with the fact that wage rates are less significantly correlated with capacity use than is labor productivity.

Statistically the best (and a surprisingly good) description of excess capacity in West Pakistan comes from a regression combining the six variables just discussed. In these data each of these industry characteristics contributes significantly to explaining variations in intersectoral utilization rates, and more than 90 percent of the total variance is explained.

$$U = 29.26 - 0.366M + 0.234X + 2.40K/Y + 0.937S + 0.034N - 1.256L$$
$$R^2 = 0.9042$$
$$F = 20.5$$

In Table 1 actual capacity utilization is shown for each industry, along with the values for the variables.

Other influences. The rate of growth of an industry appears to be highly correlated (positively) with capacity use, but it is highly correlated, too, with the capital-income ratio and the latter gave better statistical correlations with utilization rates. Imported raw-material dependence certainly represents the most important characteristic omitted so far as a widely accepted reason for excess capacity in developing countries. The reason imported raw materials were omitted from the analysis above is, similarly, that they are highly correlated with competing imports and the problems of multicollinearity clearly intrude. It has been suggested that there is a relationship between levels of utilization and the use to which an industry's products are put—consumption-goods firms are held to operate at generally higher levels than intermediate or capital-goods firms. In the Pakistan data simple averages do show patterns; consumption-goods industries appear to operate at somewhat higher levels of utilization than capital goods, and intermediate goods are more irregular. But few industries' output can be classified simply as consumption goods or capital goods and in any case the relationship adds little to the statistical explanation.

Table 1: Utilization Data

P.S.I.C.	Industry.	Utilisation rates.		Reporting units.	Average size.	Imported Raw material.	Labour productivity.	Competing imports. 1959/60.	Exports 1959/60.	Rate of growth.	Capital–income ratio.
		Unadjusted.	Adjusted.								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2070	Sugar	50·28	50·28	11	299·90	8·71	8·30	0·10	2·36	293·37	1·19
2091	Edible oils	66·73	38·11	131	28·55	0	1·49	3·40	0	523·05	1·72
2092	Tea	91·09	36·44	5	308·57	1·18	—	0·60	23·99	38·47	—
2099	Miscellaneous food	49·43	22·32	57	16·43	25·46	1·09	26·20	18·14	230·44	1·34
2100	Beverages	44·40	17·76	24	10·47	23·96	3·25	37·80	0·01	45·25	1·34
2200	Tobacco	49·66	19·86	45	77·55	9·77	14·33	0·40	0·10	456·76	0·85
2311	Cotton textiles	94·32	69·73	668	24·08	16·10	1·28	2·70	21·73	218·23	4·87
2314	Silk and art silk	72·00	28·93	201	7·62	78·88	1·80	49·00	0·01	199·27	2·34
2420	Footwear	44·36	17·75	57	6·46	55·56	—	0·20	—	109·50	—
2500	Wood, cork and furniture	60·19	24·07	46	4·36	19·32	1·32	17·30	2·07	508·02	0·93
2700	Paper	44·48	20·87	11	2·90	63·46	3·16	33·40	1·16	420·38	2·88
2800	Printing/publishing	52·00	20·80	149	4·97	41·10	1·74	11·10	1·70	220·63	1·67
2900	Leather	65·48	62·75	55	6·26	22·06	1·37	1·10	98·34	413·03	0·52
3000	Rubber	47·41	18·97	42	8·60	63·41	—	66·10	1·44	218·43	2·12
3114	Fertilisers	79·77	79·77	3	296·72	7·58	1·35	58·10	54·66	2728·97	13·56
3150	Soaps/perfumes	43·57	22·85	86	18·37	51·10	—	5·80	0·95	365·98	—
3191	Matches	142·44	56·97	1	105·81	25·77	—	0	0	71·55	—
3199	Miscellaneous chemicals	45·26	18·68	124	26·92	29·89	4·80	60·70	10·28	621·25	1·45
3200	Petroleum	45·41	45·41	5	973·06	49·12	—	67·20	14·96	209·95	1·97
3300	Non-metallic minerals	67·16	42·52	80	16·21	25·79	2·67	22·00	0·59	291·28	3·60
3400	Basic metals	40·40	16·16	97	19·15	85·74	1·90	56·00	1·22	705·87	3·09
3500	Metal products	48·71	19·48	295	3·72	71·34	1·46	56·00	4·66	437·64	1·17
3600	Non-electrical machinery	35·82	14·33	252	3·32	30·53	1·48	87·30	1·57	876·83	1·97
3700	Electrical machinery	40·33	16·13	173	12·35	74·46	2·13	69·70	0·09	1325·77	1·91
3800	Transport	53·37	21·35	183	8·49	78·19	1·67	65·50	10·04	1013·69	5·82
3900	Miscellaneous manufacturing	49·82	20·81	197	3·60	42·07	1·83	67·60	68·54	627·41	2·08

Columns 3 and 4: Unadjusted rates were those reported to CMI on the basis of production "capacity." These were adjusted to a standard of 100 hours per week as 100 percent utilization, except where actual production was higher than that.

SOURCE: CMI and other official data, in some cases processed in secondary sources.

The Significance of the Evidence

Despite shortcomings, these industrial data of West Pakistan yield a considerable amount of information and appear to be reasonably catholic in their implications. No significant results can be traced to parochially Pakistan causes; the important relationships, and the structure of excess capacity, might reasonably be expected in any developing country that had followed an import-substitution policy of industrialization. Three kinds of general conclusions emerge from the analysis:

First, product market and demand differences between industries appear less important than supply-technology-cost-investment differences. The type of market—consumption, intermediate or investment—was not directly relevant, though it may indirectly influence the technological factors. Export and import volume, which might be strictly demand phenomena, seem to operate instead through investment and supply [demonstration omitted]. The major effect of trade policy appears in imported raw-material availability, though there is reason to suspect that even this strictly supply phenomenon operates more through license-induced capacity creation than as a direct restriction to production. Of all the strictly market elements, only

market power seems clearly to influence capacity use, and it appears to operate indirectly as an expression of the preferences of those managers who are better able to indulge their preferences.

Second, while inefficiency and dubious economic policies appear directly to have created some excess capacity, they cannot provide the major explanation for its level of pervasiveness—in fact, they appear to account for only a small portion of the existing excess capacity. The explanations for excess capacity in underdeveloped countries that do rest on inefficiency and are consistent with this analysis are: 1) that import license-induced capacity is often redundant; 2) that import substitution industrialization policies may proceed without supporting raw materials; and 3) that capital flight can be achieved through capital-goods imports, regardless of intended utilization.

Finally, the most important aspect of these empirical results is the fact that they are so consistently compatible with an essentially economic analysis of capacity utilization and support its applicability to underdeveloped countries. For all the difficulties of inferring the effects of elasticities from the data, capital-income ratios are positively associated with utilization while, ceteris paribus, labor productivity is negatively associated; and the strong influence of average firm size supports Marris' stress on scale economies. This broad confirmation is of great importance, because if capacity utilization is in large part a rational economic response to identifiable economic circumstances and if these responses operate in underdeveloped countries, then a new area of planning is opened up in which it may well be possible to increase the rate of growth by changing the circumstances that determine capacity utilization.

Utilization Policies

Any description of planning policies to increase aggregate utilization of capacity in underdeveloped countries must be sketchy at best, but the broad outlines are clear: effective utilization policies will change people's preferences towards night work; they will change their rewards for undertaking it or they will change the pattern of whose preferences count the most in the aggregate. There are, in addition, differences in shift costs that are not due to preferences, and these, too, influence utilization levels.

Preferences. A reduction in the popular antagonism to night work is a most effective way to increase utilization rates, since it increases utilization in itself by reducing the costs of shift work at the same time that it makes any other policy measures more effective by reducing resistance to them. Part of people's aversion to night work is due to inconvenience and loneliness, both of which would be changed if a larger proportion of the population worked at night. The implications of this are two: a) that any increase in the amenities of night work—

especially in scale-sensitive services like police protection, transport, food—influence utilization rates; and b) that planners considering shift-work expansion should not weigh too heavily existing aversions to night work, recognizing that preferences will change when night work is more widespread.

Shift differentials in underdeveloped countries present both a paradox and apromising opportunity to influence utilization rates. If there is widespread unemployment, the worker's decision is between night work and being unemployed. Competition to get any job at all should eliminate the need for payment of a shift differential, regardless of underlying preferences between night work and day work. In fact, however, the shift differentials required by legislation in underdeveloped countries are a great deal larger—25-50 percent above day-time wage rates—than those paid in advanced countries—about 10 percent. Even though such laws are often ignored in practice, it appears that where capital is most scarce and labor most abundant, official policies compound the scarcity of capital and the unemployment of labor. We can only speculate as to why this should be; the alternatives are:

a) That preferences against night work in traditional societies are so very strong that most people would rather be unemployed than work at night.
b) That labor competent to work in industry is critically scarce despite high levels of aggregate unemployment, so the shift differential reflects the preferences and scarcity of those few workers.
c) That politicians' ideas of "advanced" social legislation, and not social preferences, increase the shift differentials.

The first and second presume that the differentials do reflect preferences. Utilization policy to influence the first could only work through changing preferences. The second is evidence of inappropriate technologies and inadequate resources devoted to training; its correction rests on reversing these. The third presumes an inaccurate expression of preferences and an inadequate appreciation of the effects of legislation; the best policy is to get rid of the existing policy.

Management preferences and incentives. The preferences of managers (rather than workers) seem to have a disproportionate importance in determining the rate of capital utilization in underdeveloped countries. This implies that utilization policies can either redistribute that power or make special efforts to change the preferences or incentives of this group. Efforts to change management preferences might prove more effective than those aimed more broadly at industrial workers and, indeed, infusion of techniques of professional management in itself may reduce antagonism to night responsibilities.

Appeals to nationalism, religion or class pride undoubtedly have an effect. That the management group is a small élite makes it easier to contact (and perhaps even to coerce), but at the same time the scarcity of management gives it a market power that reinforces its preferences for day work. And the distaste that managers in advanced countries typically feel for night work and responsibilities is probably a good deal greater in a traditional, ex-colonial society.

Incentives to increase managements' willingness to work at night can operate positively, as by subsidies dependent on utilization, or negatively by increasing the relative cost of operating during the day. One promising measure already instituted is Pakistan's tax on 24-hour-a-day capacity (replacing a tax on output in some industries). In making it more expensive to let plants sit idle, the tax may increase utilization by increasing the costs of capital, and thereby reducing the relative costs of labor and the impact of shift differentials in reducing utilization. The magnitude of the tax seems sufficient to have such effects, since it is equivalent to an additional interest rate of 12-24 percent. A simple increase in the price of capital, for example by increased tariffs on capital-goods imports, will have some of the same effect.

These policy recommendations are addressed to the non-utilization resulting mainly from preferences. In addition, governments should find it rewarding to undertake reduction of those inefficiencies in the system which result in low utilization. Most obvious are material supply bottlenecks, whether in imports or in domestic output. The planning and licensing of new investments should be far more discriminating with respect to utilization prospects. Attention to these matters can remedy particular problems, actual or foreseeable, but it will also be necessary to address policies to changes in those general preferences which seem to account for the pervasive quality of low utilization rates, and to reduce the prevailing wastage of capital by raising its cost.

These comments on utilization policies can be little more than suggestive until more is done in this important area. Of the greatest urgency are studies to establish the generality among underdeveloped countries of the empirical results presented here and the validity of the economic model of excess capacity. Only slightly less urgent are efforts to refine our understanding of what influences work preferences—to learn more about the intensities and distribution of preferences for day work and, especially, the way managers' preferences are formed and can be modified.

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